Verification of a Translation

I, the below named translator, hereby declare that:

My name and post office address are as stated below; that I am knowledgeable in the English language and in the German language, and that I believe the English translation of the attached document titled "Method and device for the improvement of the properties of a fiber material web produced in a sheet forming device" is a true and complete translation.

I hereby declare, that all statements made herein of my knowledge are true and that all statements made on information and belief are believed to be true, and further that all these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statement may jeopardize the validity of any application made thereon.

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Method and device for the improvement of the properties of a fiber material web produced in a sheet forming device

According to a first aspect, the current invention relates to a method for improving the characteristics of a fiber material web, particularly a paper, cardboard or tissue web produced from a fibrous suspension, in a sheet forming device. The fiber material web that is formed from the fibrous suspension is carried by at least one wire over a multitude of wire guiding and dewatering elements, viewed in direction of wire travel. In accordance with this first aspect, the current invention further relates to a device for the implementation of the method in accordance with the invention.
Within the scope of this description, the designation "fiber material" is used to describe fiber material derived from chemical pulp, wood pulp, recovered paper, and from a mixture of synthetic fibers.

According to a second, more general aspect, the current invention relates to a method, as well as to a device for the production of a fiber web from a fibrous suspension, particularly a paper, cardboard or tissue web.

The properties (quality) of a fiber material web produced from a fibrous suspension are substantially determined by relative motion between the fibrous suspension and the at least one wire of the sheet forming device. The formation and the bursting pressure are thereby improved to an optimum with the increasing differential between the jet speed and the wire speed ($|\Delta v| = |v_{jet} - v_{wire}|$). Other properties, for example $SCT_{transverse}$ (Short Span Compression Test) which is an important parameter for liner and test liner, are at their maximum at approximately $|\Delta v| = 0$ m/min. This applies independently of the former concept. In addition, the properties of a fiber material web that was produced from a fibrous suspension are also determined by the wire tension. The general rule applies that a

reduction in the wire tension will result in increased turbulence at the Foudrinier wire, in the dewatering zone and/or in the forming zone.

Shaking devices are used in some instances in paper machines for graphic papers, in order to improve the formation through the additionally produced shear stress.

A shaking device of this type – also referred to as a shaker in the field – is known, for example from the German prior art document by the applicant, DE 197 04 740 A1 (PB10484 DE). The disclosed shaking apparatus that causes a reciprocating motion of a body along an axis of said body, especially of a roll in a paper machine, comprising a first eccentric drive that is connected with the body in the direction of the body's axis, with a first motor and a first shaking frequency; and comprising a second eccentric drive that is connected with the body in the direction of the body's axis, with a second motor and a second shaking frequency. The eccentric position of the two eccentric drives is adjustable relative to each other, in order to adjust the stroke of the reciprocating motion of the body. In addition, the shaking apparatus is equipped with a controller by means of which the relative position of the second motor is adjustable through a cascade action control that is dependent upon the relative position of the first motor.

One disadvantage of the already familiar shaking apparatus is the fact that the formation changes periodically with the dual shaking frequency. For example: at a shaking frequency of f = 300 1/min and a wire speed of v = 900 m/min the wire moves at between maximum and minimum transverse acceleration of 0.75 m.

DE 297 14 908 U1 describes a forming shoe with perforations whose length viewed transversely to the direction of machine travel is only half that of the wire width at most. The perforations that may, for example be slot- like, slant with at least one of their main axis

toward the direction of wire travel. The perforations may be offset toward each other, transversely to the direction of wire travel. The forming shoe may be equipped with a curved surface and suction.

It is therefore an objective of the inventive device to create a method and an apparatus for improving the properties of a fiber web, particularly a paper, cardboard or tissue web produced from a fibrous material suspension in a sheet forming device, whereby the properties that require a stronger fiber orientation transversely to the direction of wire travel are improved without essentially detrimentally affecting those properties that profit from a stronger relative motion between the fibrous suspension and the at least one wire of the sheet formation device.

The first-mentioned properties (transverse strengths) include for example $SCT_{transverse}$, Tear $length_{transverse}$ and flexural $strength_{transverse}$ whereas the formation, for example, would come under the category of the second-mentioned properties.
Within the scope of this description, the term "properties" is used for the fiber material web in its entirety, as well as for at least a section of said web.

This objective is met in accordance with the current invention by a method of the type mentioned at the beginning whereby cross flows are created in the fiber suspension relative to the direction of wire travel, in order to achieve better web properties and higher transverse strength.
These cross flows subject the fibrous suspension to additional shear stresses that tear open existing fiber flakes and cause a stronger fiber orientation transversely to the direction of wire travel, resulting in improved web properties and higher transverse strengths.

The transverse flows are to be produced preferably by at least one wire guiding or dewatering element that is structured and/or directed transversely to the direction of wire

travel, since this element initiates hydrodynamic impulses in the fibrous suspension that are effective transversely to the direction of wire travel and that cause the aforementioned stronger fiber orientation.

The inventive objective is met with the device of the type mentioned at the beginning in accordance with the current invention in that at least one wire guiding or dewatering element is structured and/or directed transversely to the direction of wire travel in order to produce cross flows relative to the direction of wire travel, with the purpose to producing better web properties and higher transverse strengths.

The structuring in the wire guiding or dewatering element is preferably in the form of indentations and/or elevations, whereby the elevations are in the embodiment of nubs and/or crowned and/or dome shaped and/or oblong structures. These formations represent an effective medium for the production of cross flows in the fibrous suspension relative to the direction of wire travel. In addition they can be manufactured and operated cost effectively.

The wire guiding or dewatering element in a preferred embodiment can be in the form of a plate, especially a support plate, in the form of a strip, especially a support strip, in the form of inclined short foils that are preferably curved, or short strips that are preferably straight, or in the form of a rotating element, such as a grooved or spirally grooved roll, since any of these types can be installed into a sheet forming apparatus without problems. In addition, the rotating element and the wire can rotate or move at the same speed, or at different speeds (synchronism, forward motion, after-running) in the same, or in opposite direction. Naturally, the rotating element can also rotate at crawling speed, possibly even with an installed cleaning device.

With regard to the arrangement of the structured and/or directed wire guiding or dewatering element it is advantageous if – viewed in direction of wire travel – it is positioned as not to be laterally offset, or positioned to be laterally offset and staggered or laterally offset and alternating. In principle these layouts can be easily accomplished and are easily adaptable to various application instances.

With regard to the creation of cross flows relative to the direction of wire travel it is also advantageous when the structured and/or directed wire guiding or dewatering element is positioned alternating or in a pattern with a non-structured and/or non-directed wire guiding or dewatering element. This arrangement permits the creation of smaller and/or controllable cross flows relative to the direction of wire travel, resulting in better web properties and higher transverse strengths without having to incur higher investment and operating costs.

In order to noticeably increase the cross flows in the fibrous suspension relative to the direction of wire travel the structured and/or directed wire guiding or dewatering element is supported flexibly and/or rigidly, whereby in the second instance its position is adjustable relative to the wire, for example through sliding or pivoting.

To achieve continued intensification of the cross flows relative to the direction of wire travel the structured and/or directed wire guiding or dewatering element is supplied with vacuum. The vacuum supply is provided cost-effectively preferably by means of at least one controlled vacuum box.

The structured and/or directed wire guiding or dewatering element can - in an additional advantageous design of the current invention – also be in the embodiment of a spreader roll, a spreader type suction unit with a herringbone pattern, or a curved spreader bar, since these

types of units can also be installed into a sheet forming device without any problems and to be fully operative.

The structured and/or directed wire guiding or dewatering element may be installed in a hybrid former type sheet forming apparatus, whereby at least one element is installed only on the Foudrinier side or only on the hybrid former side, or on both sides.

It can however, also be installed in a gap former type sheet forming apparatus, whereby at least one element would be installed on only one side of the wire, or on both sides of the wire.

In accordance with the second more general aspect it is the objective of the current invention to cite an improved method, as well as an improved apparatus for the production of a fiber material web, specifically a paper, cardboard or tissue web whereby, in order to achieve certain properties in the end product, the main fiber direction can be influenced accordingly.

The objective is met by the inventive method for the production of a fiber material web from a fibrous suspension, especially a paper, cardboard or tissue web whereby during dewatering in the forming zone at least zonal pressure gradients are produced in the fibrous suspension, in order to influence the main fiber direction in the fiber material web accordingly.

Based on this arrangement it is, for example possible to obtain a dynamic pressure at the impact edge. This means accepting an increased wire wear and tear.

According to a preferred arrangement of the inventive, the fibrous suspension is treated with vacuum in the forming zone during dewatering.

The pressure gradient generation and/or vacuum treatment occur advantageously, in sections, transversely to the machine direction. Therefore, a cross directionally sectioned vacuum chamber can be utilized.

The pressure gradient generation and/or vacuum treatment occur preferably controlled and/or regulated.

Again, one or several dewatering, forming and/or wire guiding elements can be utilized for the generation of the pressure gradients. In principle, especially the elements described previously in connection with the first aspect of the current invention can again be utilized.

The fiber material web that is formed from the fibrous suspension can also be carried over the dewatering, forming and/or wire guiding elements by means of at least one wire.

Particularly foil strips that are positioned diagonally to the direction of web travel can be utilized as dewatering, forming and/or wire guiding elements.

For dewatering, forming and/or wire guidance at least one dewatering box can especially be used that has at least one plate cover that is equipped with diagonal slots relative to the direction of web travel and that provides a foil effect. The diagonally progressing bars in the plate cover can be beveled on the discharge side. As an option, the dewatering box can be supplied with vacuum.

In accordance with a practical embodiment of the method in according to the current invention, a controlled and/or regulated dewatering box that is supplied with vacuum is preferably used.

Advantageously, at least one dewatering box - for example of the type described in connection with the first aspect of the current invention - is used in combination with at least one graduated foil.

It is also advantageous if at least one dewatering box, for example of the type described in connection with the first aspect of the current invention is used, in combination with so-called Varioline strips (especially IBS Varioline-system). A suitable Varioline-box may, for example consist of two different strips – one dewatering strip that may for example consist of ceramic, and an adjustable strip that may for example consist of polyethylene. These two strips may be of different heights, whereby the height differential depends upon the production conditions. The strips may alternate across the box. A low vacuum pulls the moving wire downward, in direction of the Varioline strip. A wave motion is caused. This motion, as well as the pressure of the water film between the wire and the Varioline strip causes a controlled activity in the fibrous suspension. The rate of dewatering can be controlled through the level of applied vacuum, as well as through the height differential between the strips. An additional opportunity of controlling the dewatering exists in a variation of the open area of the box that is achieved by changing the widths of the strips.

An additional advantage is, if at least one dewatering, forming and/or wire guiding element possesses a curved surface over which the fibrous suspension is carried by means of at least one wire.

The curvature radius of the surface may, for example be larger than 2 m, especially larger than 5 m and preferably larger than 10 m.

The angle of wrap is preferably in a range of approximately 10° to approximately 30°.

When viewed cross directionally the dewatering, forming and/or wire guiding elements are preferably arranged in sections and/or are sectionally adjustable.

All paper and cardboard related parameters, such as for example the structural characteristics like porosity, fiber orientation, formation and strength vary across the machine width. The reason for this is, for example inconsistencies in the sheet formation and sheet drying, resulting especially in uneven shrinkage across the web width. The cross profiles are in part so poor that the rolls from the edge fetch lower prices, or in extreme instances are allocated to waste.

According to a third aspect it is therefore the objective of the current invention to cite a method, as well as an apparatus of the type referred to at the beginning with which the cross profiles of essential product properties, that is especially paper and/or cardboard properties can be improved. To this end and in order to improve the cross profiles, a sectional control and/or regulation of the sheet formation should be possible through means of sheet forming elements that are arranged in sections in cross machine direction and that permit important paper and/or cardboard properties, such as the formation and especially the L/Q (longitudinal/cross) ratios such as the TSI (tensile-stiffness-index), the Tear length, SCT, etc. to be influenced.

This objective is met by a preferred inventive embodiment that is characterized in that the adjustment parameters of the dewatering, forming and/or wire guiding elements that are -

– when viewed cross directionally – arranged in sections and/or are sectionally adjustable are adjusted correspondingly in order to influence a respective property profile of the fiber material web.

Profile related problems can therefore be countered effectively, by making appropriate variations to the adjustment parameters across the width.

In accordance with a functional, practical embodiment respective changes in the adjustment parameters of the dewatering, forming and/or wire guiding elements that are – when viewed cross directionally – arranged in sections and/or are sectionally adjustable can occur on the basis of off-line measurements, especially steady state.

Moreover, a respective change of the adjustment parameters of the dewatering, forming and/or wire guiding elements that are – when viewed cross directionally – arranged in sections and/or are sectionally adjustable can occur especially manually, via a control system or via at least a closed control loop.

In accordance with a preferred functional embodiment at least one closed control loop is utilized that encompasses an in-line acquisition of the product characteristic that is to be influenced, or a characteristic correlating with said product characteristic, a control algorithm and the relating final control element, such as especially the relating dewatering, forming and/or wire guiding element.

The product property that is to be influenced may, for example be the TSI, the fiber orientation, the flow velocity distribution, forming, etc.

As already mentioned, instead of the product characteristic that is to be influenced, a characteristic that correlates well with the target characteristic can especially be acquired

and be included in the adjustment. The following examples are cited: Most of the strengths such as tear strength, SCT and bursting pressure cannot be captured in-line since this would be associated with destructive test procedures. On the basis of, for example the fiber orientation the respective target strength can be calculated based on correlations and can, if necessary, be corrected through an adjustment. If necessary, the adjustment may consider several in-line measured variables, i.e. the oven dried FbM profile.

In certain instances it is also advantageous if at least one control algorithm is incorporated into the closed control loop, for mapping, especially with an appropriate interface control.

As already mentioned, any of the previously discussed dewatering, forming and/or wire guiding elements can be utilized as a respective final control element.

Moreover, the angle of attack of the dewatering, forming and/or wire guiding elements can be adjustable relative to the direction of web travel, in fact especially in the plane tentered by the machine direction and machine cross direction. An intervention is therefore possible, for example through adjustment of the angle of attack.

An additional potentiality exists in the utilization of a dewatering box that is equipped with several vacuum zones and/or elements that are arranged successively in transverse direction, and through which especially the longitudinal/cross relationships can be influenced.

For example a dewatering box comprising a cover or plate that is diagonally slotted relative to the direction of web travel can be utilized. In addition the utilization of a dewatering box that is equipped with foil strips that are arranged diagonally to the direction of web travel is also feasible.

The vacuum in the individual vacuum zones is preferably individually controllable. Therefore, an intervention is also possible for example by adjusting the vacuum in the individual zones. Typical values for the vacuum are for example in a range of 0 to approximately 50 kPa, preferably in a range of 0 to approximately 25 kPa. However, values exceeding 50 kPA are also possible. As a rule they determine smaller slot widths and/or lower wire tensions. They have however hitherto not been used due to high vacuum costs and "sheet sealing".

In accordance with a modified embodiment of the method according to the current invention, the dewatering, forming and/or wire guiding elements or the dewatering box can be equipped with at least one slot having a changeable slot width.

In addition to the adjustable slot width a vacuum supply that is sectioned in cross direction can also be provided.

In certain instances it is however advantageous if only the slot width is adjustable, in other words if no vacuum application that is sectioned in cross direction is available.

In particular, distortable foil strips can also be utilized. They may consist of either a soft deformation-permitting material or may be sectioned across the width. An intervention is possible in this instance by adjusting the effective foil angle, whereby typical values are in a range of 0° to approximately 4°.

Alternatively, or in addition the zones that are located successively in cross direction may partially overlap. Among other attributes, a soft profile is achieved. Formation of stripes is avoided.

In this instance too, any combination of the previously discussed steps is possible.

The installation location of the elements that are cross profiled and arranged in zones, is especially in the area between the headbox and the water line. The stock consistency range of 0.1% to 7% can roughly be considered as the operative range. The stock consistency prevailing at the waterline depends on the product, or more precisely on the utilized fiber raw material (fiber length).

In sack paper produced from long fiber raw material with a low content of refined long-fiber pulp, the stock consistency is in a range of approximately 0.1% to approximately 5%, preferably in a range of approximately 0.2% to approximately 3.5%.

In products that are based on secondary fiber material the stock consistency is in a range of approximately 0.3% to approximately 7%, and preferably in a range of approximately 0.5% to approximately 5%. The same values are to be found in wood pulp that is ligneous primary fiber material having a respective fiber length of between long fibers and secondary fiber material. This would also include, for example GW (ground wood), PGW (pressurized ground wood), TMP,CTMP and RMP (refined mechanical pulp).

The respective foil angle can specifically be in a range of 0° to approximately 5° and preferably in a range of 0° to approximately 3°.

The dewatering box can basically also be equipped with at least one perforated cover or at least one perforated plate.

In accordance with a functional embodiment of the current inventive method a forming board, a dewatering box with at least one slotted or perforated cover or plate, and specifically several foil boxes can be used, over which the wire is carried.

The fibrous suspension can be treated specifically with vacuum in a range of 0 kPa to approximately 50 kPa, and preferably in a range of 0 kPa to approximately 25 kPa
The relating elements can be utilized, especially in the following areas:

- in the forming process of the fibers, that is in an area in which the fibers are still mobile and the point of immobility has not yet been reached. This applies generally to the range of the medium stock consistency of 0.1% to approximately 7%, preferably 0.5% to approximately 5%.
- particularly in stocks containing recovered paper (for example liner, carton, graphic papers), having a medium stock consistency $\bar{c}$ *of: 0.3%* $\leq \bar{c} \geq$ 7% ($\hat{=}$ 3 g/l $\leq \bar{c} \leq$70 g/l); and
- with sack Kraft papers: 0.1% $\leq \bar{c} \leq$4%

The current invention is applicable, particularly for a Foudrinier former, a twin wire former, especially a gap-former or hybrid former, or a graphic former. By definition, a graphic former may be a former for graphic papers, wrapping papers, cardboard, tissue or specialty papers.

In addition, the current invention provides also an advantage in a machine that is equipped with several sheet forming units for the production of multi-layer products, especially for the reduction of curling tendency. Here, the control or regulator system may, for example affect only one ply. In certain applications however, it is advantageous if the control or regulator system is effective upon at least two plies. Yet, at the same time the control or regulator system can, for example, be effective upon all plies.

The current invention can be utilized advantageously to influence at least one of the following properties of the fiber material web:

- Forming
- Tear length ratio R_L/R_Q

The aforementioned Tear ratio is especially significant with sack papers and format-type papers like wood-free copying paper.

The objective concerning the second more general aspect is met according to the current invention by a device for the production of a fiber material web, particularly a paper, cardboard or tissue web from a fibrous suspension. The said device comprises a forming zone and means by which at least zonal pressure gradients are produced in the fibrous suspension during dewatering in the forming zone, in order to appropriately influence the principal fiber orientation.

Preferred design forms of the device according to the current invention are cited in the sub-claims.

In addition to the RL (Tear length) and formation the current invention can also influence the TSI behavior (TSI = tensile stiffness index) as desired.

When using a diagonally slotted plate cover, designed according to the invention, a reduction of the longitudinal/cross ratio of i.e. 0.3 to 0.5 was achieved.

As already mentioned, the current invention is also applicable especially twin wire formers.

An appropriate diagonally slotted plate can for example also be utilized in a gap-former (i.e. DuoBase) or in a graphics former; for example also equipped with diagonal opposing blades or strips.

With small wrap angles, especially in a range of approximately 10 to approximately 30°, a positive effect of a longitudinal/cross reduction occurs. Due to the deflection losses occurring in the slots and at equal static pressure (air or wire tension pressure) the jet speed upon the wire is reduced. With a diagonal placement of strips the braking effect causes a decrease of the speed of the suspension on the wire – viewed in direction of machine travel – and that of neighboring jets at somewhat different times. This can lead to a transverse shear effect (longitudinal/transverse decrease).

Any combination of controlled and/or regulated dewatering, forming and/or wire guiding elements is possible, either interrelated or with other known dewatering, forming and/or wire guiding elements that are not transversely structured. Below is a listing of possible examples that would be feasible:

- same-type elements follow in direction of machine travel
    - not laterally offset
    - laterally offset staggered
    - laterally offset alternating

- transversely structured elements, combined with non-transversely structured elements.

It is understood that the previously referred to characteristics of the current invention, as well as those yet to be explained below can be utilized not only in the cited combinations, but also in other combinations, or on their own without leaving the scope of the current invention.

Additional characteristics and advantages of the invention result from the sub-claims and the following description of preferred embodiment examples, with reference to the drawings; these illustrate:

Fig. 1 through 7: various design forms of the inventive device, with a multitude of wire guiding and dewatering elements;

Fig. 8: a schematic partial view of a forming zone, in this instance comprising a Foudrinier former; in this example a schematic partial view of a Foudrinier former in a device for the production of a fiber material web, whereby said device is equipped with means for the generation of at least one zonal pressure gradient;

Fig. 9: a schematic top view of a plate equipped with diagonal slots for the generation of a pressure gradient;

Fig. 10 through 17: various diagrams, reproducing test results achieved with or without vacuum, with a diagonally slotted plate suction box that are representative of paper quality parameters resulting directly from the drawings.

Fig. 18: a schematic top view of a first installation example of an arrangement of foil strips that are arranged diagonally relative to the direction of machine travel;

Fig. 19: a schematic top view of a second installation example of an arrangement of foil strips that are arranged diagonally relative to the direction of machine travel;

Fig. 20: a schematic top view of a segment of a toothed bar arrangement, showing a stationary toothed bar and a toothed bar, that is sectioned in transverse direction;

Fig. 21: a schematic top view of a segment of an arrangement consisting of several diagonally slotted covers, located successively in direction of wire travel; and

Fig. 22: a schematic illustration of a paper machine, comprising means for cross-profiling in the wire section.

Fig. 1 shows sections of a top view of a device 1 intended for the improvement of the properties of a fiber material web 2.1, especially a paper, cardboard or tissue web produced from a fibrous suspension 2 in a sheet forming device that is not illustrated in detail that, however, is known to the expert. The fiber material web 2.1 that is formed from the fibrous suspension 2 is carried over a multitude of wire guiding and dewatering elements 4, when viewed in direction of wire travel S (arrow) by means of a wire 3.1. Figure 1 illustrates only one wire guiding or dewatering element 4.

The current invention provides that the wire guiding or dewatering elements 4 are structured and/or directed transversely to the direction of wire 3.1 travel S (arrow) in order to thereby produce cross flows Q (arrow) relative to the direction S of wire 3.1 travel, with the purpose of achieving better web properties and higher transverse strengths.

The structuring 5 in the wire guiding or dewatering element 4 shown in Figure 1 is in the form of indentations 7.1, whereby the wire guiding or dewatering element 4 is in the embodiment of a plate 6, especially a support plate.

Figure 2a shows top views of two wire guiding or dewatering elements 4 in the form of strips 4.1, especially support bars according to the current invention that are positioned parallel to each other whose structuring 5 is in the form of elevations 7.2. The elevations 7.2 may be in the embodiment of nubs and/or crowned and/or dome shaped and/or oblong structures.

Figure 2b - viewed in direction of wire travel S (dimensional arrow) - shows a wire guiding or dewatering element 4 in the form of a strip 4.1 with nub type 8 structures 5 .

The at least one wire is not illustrated in either of the Figures 2a and 2b.

Figures 3a and 3d further show top views of wire guiding and dewatering elements 4 according to the invention, all of which are designed as inclined curved short foils 4.2, or straight short foils 4.3. The at least one wire is not illustrated.
As depicted in Figures 3a and 3b, the short foils 4.2 and short strips 4.3 are positioned in several rows diagonally to the direction of wire travel S (arrow) and parallel to each other. In Figure 3c the short strips 4.3 are positioned in a herringbone pattern (2 rows), transversely to the direction of wire travel S (arrow), together with overlap Ü, offset V and separation T at angles α_1 α_2. In contrast, the short strips 4.3 in Figure 3d are arranged at an angle α toward each other, including overlap Ü, viewed in direction of wire travel S (arrow).

The structured and/or directed wire guiding or dewatering elements 4 depicted in Figures 1 through 3d may be installed in a sheet forming device in the embodiment of a hybrid-former, whereby they may be located only on the Foudrinier side or only on the hybrid-former side, or on both sides. A hybrid-former of this type is already known, for example from the applicant's German prior art document DE 197 06 940 A1 (PB10504 DE); the disclosure of this prior art document is herewith declared to be part of this description and the hybrid-former will, therefore, not be discussed in further detail.
The depicted wire guiding or dewatering elements 4 can obviously also be installed in a sheet forming device in the form of a gap-former. In this instance they can be located on only one wire side, or on both wire sides.

Figures 4a through 4c each show two wires 3.1, 3.2 – viewed in direction of wire travel S (dimensional arrow) of a gap-former that is not illustrated here in detail, whereby the fibrous suspension is run between the two wires 3.1 and 3.2. A gap-former of this type (Twin Wire Former) is known, for example from the applicant's German prior art document E 40 05 420 A1 (PB04713);

the disclosure of this prior art document is herewith declared to be part of this description and the gap-former will, therefore, not be discussed in further detail.
Figure 4a shows the wire 3.1 being carried over a rotating element 9 that is in the embodiment of a roll 10, shown as a sectional view. The surface of the roll 10 can be grooved or spirally grooved. In contrast, the wire 3.2 is carried by means of a plate 6 or a strip 4.1 that are structured 5 with nubs 8. The rotating element 9 and the wire 3.1 can rotate or move at the same, or at different speeds (synchronism, forward motion, after-running) in the same, or in opposite direction. Naturally, the rotating element 9 can also rotate at crawling speed, possibly even with an installed cleaning unit that however, is not illustrated.

In Figures 4b and 4c both wires 3.1, 3.2 are each carried over a plate 6 or a strip 4.1, that are provided with nub-type 8 structuring 5. In both figures it can be clearly seen that the nubs – viewed in direction of wire travel – are positioned to be not laterally offset (Figure 4b) or to be laterally offset and staggered (Figure 4c) or laterally offset and alternating (4c).

It is understood that the elevations (7.2) that are in the form of nubs 8 can also be developed as indentations and/or crowned and/or dome shaped and/or oblong structures. The nubs 8, as well as also the other possible elevations and indentations represent the wire guiding or dewatering element 4 according to the invention.

Figure 5 shows a top view of the wire guiding or dewatering element 4 according to the invention, whereby short strips 4.3 are located in a row, crossing diagonally over at an angle α and whereby the wire is not illustrated.

In addition, the wire guiding or dewatering element according to the invention can also be positioned alternating or in a pattern with a non-structured and/or non-directed wire guiding or dewatering element. The wire guiding or dewatering element according to the invention can also be supported flexibly and/or rigidly, whereby in the second instance its position is adjustable relative to the wire, for example through sliding or pivoting. The wire guiding or dewatering element according to the current invention can, moreover, be supplied with vacuum and whereby the vacuum supply – with regard to cost-effectiveness - can occur by means of at least one preferred regulated/controlled vacuum box.

Since the various elements of these additional design variations are already known from the state of the art, or are easily deductive, further explanations are dispensed with.

Figures 6 and 7 show two additional structured and/or directed wire guiding or dewatering elements 4, according to the inventive device 1. Figure 6 is a top view of a spreader type suction unit 11 with a herringbone pattern, carrying a wire 3.1. In contrast, Figure 7 is a perspective view of a curved spreader bar 12 in simplified form. A spreader roll is not illustrated, since it is known in the state of the art and has numerous uses in many applications.

All structured and/or directed wire guiding or dewatering elements have in common that they can be utilized individually and/or in multiples and/or in combination of various types.

In summary it is to be stated that under this first aspect of the invention, a method and a device are created to improve the properties of a fiber material web, particularly a paper,

cardboard or tissue web produced from a fibrous suspension in a sheet forming device, whereby the properties that require a strengthened fiber orientation transversely to the direction of wire travel are improved without essentially detrimentally affecting those properties that profit from stronger relative movement between the fibrous suspension and the at east one wire of the sheet forming device.

In accordance with the second aspect of the current invention a method, as well as a device for the production of a fiber material web, specifically a paper, cardboard or tissue web from a fibrous suspension are generally cited, whereby during dewatering in the forming zone at least zonal pressure gradients are produced in the fibrous suspension, in order to influence the main fiber direction in the fiber material web accordingly.

Figure 8 shows a schematic partial view of a forming zone 14, in this instance a Foudrinier-Former in an example of a device for the production of a fiber material web that is equipped with means for the generation of at least one zonal pressure gradient.

A wire 16 can be seen that is carried over a forming board 18, a dewatering box 20 that is equipped with two relative to the machine or web direction diagonally slotted plate covers, or plates 22, 24 and several foil boxes 26. As can be seen in Figure 8, the dewatering box is equipped with a discharge 28. The dewatering box can be equipped with suction, whereby the fibrous suspension can, for example be treated with vacuum in a range of 0 kPa to approximately 50 kPa, and preferably in a range of 0 kPa to approximately 25 kPa.

Figure 9 illustrates a schematic top view of an example design of a diagonally slotted plate 30 that serves to generate pressure gradients and whose slots 32 in this instance are inclined 45° opposite the direction of machine travel L.

As an option, the surface of the diagonally slotted plate 30 facing the wire may be curved. The curvature radius of the surface may, for example be larger than 2 m, particularly larger than 5 m and preferably larger than 10 m.

Figures 10 through 17 illustrate various diagrams that reproduce test results that were achieved with and without vacuum on a diagonally slotted plate suction unit and that are representative of paper quality parameters resulting directly from Figures 10 through 17.

Figure 18 is a schematic top view of a first installation variation of an example arrangement (SSPS) of foil strips or diagonal slots that are positioned diagonally relative to the direction of machine travel. As can be seen in Figure 18, two groups of foil strips and 36 are provided. In the present example, the foil strips 34 of the one group are aligned differently than the foil strips 36 of the other group. The foil strips 34 or 36 have a run-off pitch in the range of 0° to 5°.

Figure 19 is a schematic top view of a second installation variation of an example arrangement of foil strips or diagonal slots 36 that are located diagonally relative to the direction of machine travel. In this instance too, two groups of foil strips 36 are again provided. In this instance however, the foil strips 36 of these two groups are aligned same-directionally.

Figure 20 is a schematic partial top view of a toothed bar arrangement 38, showing a stationary continuous toothed bar and a toothed bar 42 that is sectioned in cross direction.

As can be seen from Figure 20, the toothed bar arrangement 38 extends transversely to the direction of wire travel L.

Various sections i are defined by the various adjustable sectional toothed bar segments 44 of the sectioned toothed bar 42. An actuator 46 is allocated to each of the respective toothed bar segments 44 through which the relating toothed bar segment 44 is adjustable as desired. At the same time, the stationary continuous toothed bar 40, and the various toothed bar segments 44 collaborate in the illustrated manner, whereby in the toothed bar segments 44 in the present example are adjustable in direction of wire travel L.

Figure 21 is a schematic top view of a section of an arrangement consisting of several diagonally slotted covers 48, 50 and 52 that are located successively in direction of wire travel L.

As can be seen from Figure 21, the covers 48, 50 and 52 always extend transversely to the direction of wire travel L. The slots 54 are always placed diagonally relative to the direction of wire travel L.

As can also be seen from Figure 21, the slots 54 in the respective covers 48, 50 and 52 can be positioned parallel to each other, at least in sections, or differently. In addition the slots 54 can have the same length as each other, at least in sections, or they can be of different lengths. Orientation and length of the slots 54 in a cover can differ from the slots 54 in another cover – a fact that is however, not imperative. Furthermore they can be provided particularly as previously described in detail.

The slot width b can, for example, be in a range of approximately 10 mm to approximately 100 mm, that is to say a slot width in direction of travel can be in the range of 14 mm to 140 mm, preferably of 25 mm to 100 mm.

As can be seen in Figure 21 a zone separation that runs parallel to the diagonal slots 54 can, for example be provided at the respective locations 56.

Figure 22 is a schematic illustration of a purely exemplary layout of a paper machine whereby means for cross profiling are provided in the wire section 58.

In the present example the fibrous suspension 62 that is delivered from the headbox 60 is brought onto a wire 64 that, in the wire section 58 is routed over a forming board 66, a suction box 68 together with the relating elements for controlling the cross profile, for example at least one foil box 70, at least one suction box 72 and one suction couch roll 74.

Following this wire section, the fiber material web, or paper web runs through a press section 76, a dryer section 78 and a smoothing device 80 in order to be subsequently delivered to a roller 82. Scanners 84 that are connected with a control unit 86 are provided in the area of the suction couch roll 74, the press section 76, the dryer section 78, the smoothing device 80 and for example also the roller 82. A valve arrangement 88 through which various sections of the suction box 60 can be treated with vacuum via a vacuum generator 90 is triggered by the control unit 86.

Accordingly, controlling the cross profile is possible, as already previously described.

Component identification

1	Device
2	Fibrous suspension
2.1	Fiber material web
3.1, 3.2	Wire
4	Wire guiding or dewatering element
4.1	Strip
4.2	Short foil
4.3	Short strip
5	Structuring
6	Plate
7.1	Indentation
7.2	Elevations
8	Nub
9	Rotating element
10	Roll
11	Spreader type suction unit
12	Spreader bar
14	Forming zone, Foudrinier-Former
16	Wire
18	Forming board
20	Dewatering box
22	diagonally slotted plate cover
24	diagonally slotted plate cover
26	Foil box
28	Discharge
30	diagonally slotted plate
32	Slot
34	Foil strip (diagonal strip)

36	Foil strip (diagonal strip)
38	Toothed bar arrangement
40	Stationary continuous toothed bar
42	sectioned toothed bar
44	Toothed bar segment
46	Actuator
48	diagonally slotted cover
50	diagonally slotted cover
52	diagonally slotted cover
54	Slot
56	Zone separation
58	Wire section
60	Head box
62	Fibrous suspension
64	Wire
66	Forming board
68	Suction box
70	Foil box
72	Flat suction box
74	Suction couch roll
76	Press section
78	Dryer section
80	Smoothing device
82	Roller
84	Scanner
86	Controller
88	Valve arrangement
90	Vacuum generator

b	Slot width
L	Direction of machine travel
Q	Cross flow (arrow)
S	Direction of wire travel (arrow)
T	Separation
Ü	Overlap
V	Offset
α, α_1, α_2	Angle

Method and device for the improvement of the properties of a fiber material web produced in a sheet forming device

Patent Claims

1. Method for improving the characteristics of a fiber material web (2.1), particularly a paper, cardboard or tissue web produced from a fibrous suspension (2), in a sheet forming device. The fiber material web (2.1) that is formed from the fibrous suspension (2.1) is carried by at least one wire (3.1, 3.2) over a multitude of wire guiding and dewatering elements (4), viewed in direction of wire travel (S),
characterized in that
cross flows (Q) are created in the fibrous suspension (2) relative to the direction of wire (3.1) travel (S), in order to achieve improved web properties and higher transverse strengths.

2. Method in accordance with claim 1,
characterized in that
the transverse flows (Q) are produced by means of at least one wire guiding or dewatering element (4) that is structured and/or directed transversely to the direction of wire travel (S).

3. Device (1) for improving the characteristics of a fiber material web (2.1), particularly a paper, cardboard or tissue web produced from a fibrous suspension (2), in a sheet forming device. The fiber material web (2.1) that is formed from the fibrous suspension (2.1) is carried by at least one wire (3.1, 3.2) over a multitude of wire guiding and dewatering elements (4), viewed in direction of wire travel (S),
characterized in that

at least one wire guiding or dewatering element (4) is structured and/or directed transversely to the direction of wire travel (S) in order to produce cross flows (Q) relative to the direction of wire travel (S), with the purpose to producing better web properties and higher transverse strengths.

4. Device (1) in accordance with claim 3,
characterized in that
the structuring (5) in the wire guiding or dewatering element (4) is in the form of indentations (7.1)

5. Device (1) in accordance with claim 3,
characterized in that
the structuring (5) in the wire guiding or dewatering element (4) is in the form of elevations (7.2).

6. Device in accordance with claim 5,
characterized in that
the elevations (6.2) in the wire guiding or dewatering element (4) are in the embodiment of nubs (8) and/or crowned and/or dome shaped and/or oblong structures.

7. Device (1) in accordance with one of the claims 3 through 6,
characterized in that
the wire guiding or dewatering element (4) is in the form of a plate (6), especially support plates, and/or in the form of a strip (4.1), especially support strips.

8. Device (1) in accordance with claim 3,
characterized in that

The wire guiding or dewatering element (4) is in the form of inclined short foils that are preferably curved, or short strips (4.3) that are preferably straight.

9. Device (1) in accordance with claim 3,
characterized in that
the wire guiding or dewatering element (4) is in the form of a rotating element (9), such as a grooved or spirally grooved roll (10).

10. Device (1) in accordance with claim 9,
characterized in that
the rotating element (9) and the wire (3.1, 3.2) can rotate or move at the same speed, or at different speeds (synchronized, forward motion, after-running) I the same, or in opposite direction.

11. Device (1) in accordance with claim 9 or 10,
characterized in that
the rotating element (9) can rotate at crawling speed, and preferably comprises a cleaning device.

12. Device (1) in accordance with one of the claims 3 through 11,
characterized in that
the structured and/or directed wire guiding or dewatering element (4) – viewed in direction of wire travel – is positioned as not to be laterally offset, or positioned to be laterally offset and staggered or laterally offset, alternating.

13. Device (1) in accordance with one of the claims 3 through 12,
characterized in that

the structured and/or directed wire guiding or dewatering element (4) is arranged alternating or in preferably another pattern with a non-structured and/or non-directed wire guiding or dewatering element.

14. Device (1) in accordance with one of the claims 3 though 13,
characterized in that
the structured and/or directed wire guiding or dewatering element (4) is supported flexibly.

15. Device (1) in accordance with one of the claims 3 through 13,
characterized in that
the structured and/or directed wire guiding or dewatering element (4) is supported rigidly, whereby their positions relative to the wire (3.1, 3.2) are adjustable for example trough sliding or pivoting.

16. Device (1) in accordance with one of the claims 3 through 15,
characterized in that
the structured and/or directed wire guiding or dewatering element (4) is supplied with vacuum in order to achieve intensification of the transverse flows (Q) relative to the direction of wire (3.1, 3.2) travel (S).

17. Device (1) in accordance with claim 16,
characterized in that
the vacuum supply is provided by means of at least one, preferably controlled/regulated vacuum box.

18. Device (1) in accordance with one of the claims 3 through 17,
characterized in that
the structured and/or directed wire guiding or dewatering element (4) can be in the embodiment of a spreader roll, a spreader type suction unit (11) with a herringbone pattern, or a curved spreader bar (12).

19. Device (1) in accordance with one of the claims 3 through 18,
characterized in that
the sheet former can be in the embodiment of a hybrid-former; and in that at least one structured and/or directed wire guiding or dewatering element (4) is installed only on the Foudrinier side or only on the hybrid-former side, or on both sides.

20. Device (1) in accordance with one of the claims 3 through 18,
characterized in that
the sheet former is in the embodiment of a gap-former and at least one structured and/or directed wire guiding or dewatering element (4) is installed only one side of the wire, or on both sides of the wire.

21. Method for the production of a fiber material web, especially a paper, cardboard or tissue web from a fibrous suspension, especially in accordance with one of the aforementioned claims, whereby during dewatering in the forming zone at least zonal pressure gradients are produced in the fibrous suspension, in order to influence the main fiber direction in the fiber material web accordingly.

22. Method in accordance with claim 21,
characterized in that
the fibrous suspension is treated with vacuum during dewatering in the forming zone.

23. Method in accordance with claim 21 or 22,
characterized in that
a sectional pressure gradient generation and/or vacuum treatment occurs transversely to the machine direction.

24. Method in accordance with claim 23,
characterized in that
a cross-directionally sectioned vacuum chamber is utilized.

25. Method in accordance with one of the aforementioned claims,
characterized in that
a controlled and/or regulated pressure generation and/or vacuum application occurs.

26. Method in accordance with one of the aforementioned claims,
characterized in that
one or several dewatering, forming and/or wire guiding elements are utilized for the generation of the pressure gradients.

27. Method in accordance with claim 26,
characterized in that
the fiber material web that is formed from the fibrous suspension is carried by means of at least one wire over the dewatering, forming and/or wire guiding elements.

28. Method in accordance with claim 27 or 28.
characterized in that
foil strips that are positioned diagonally to the direction of web travel are utilized as dewatering, forming and/or wire guiding elements

29. Method in accordance with one of the aforementioned claims,
characterized in that
for dewatering, forming and/or wire guidance at least one dewatering box is used that has at least one relative to the direction of web travel diagonally slotted plate cover and that provides a foil effect.

30. Method in accordance with claim 29,
characterized in that
the diagonally progressing bars in the plate cover are beveled on the discharge side.

31. Method in accordance with claim 29 or 30,
characterized in that
the dewatering is supplied with vacuum.

32. Method in accordance with one of the aforementioned claims,
characterized in that
a controlled and/or regulated dewatering box that is supplied with vacuum is preferably used.

33. Method in accordance with claim 31 or 32,
characterized in that
at least one dewatering box is used in combination with at least one graduated foil

34. Method in accordance with one of the aforementioned claims
characterized in that
at least one dewatering box is used in combination with so-called Varioline-strips (especially IBS Varioline-system).

35. Method in accordance with one of the aforementioned claims,

characterized in that

at least one dewatering, forming and/or wire guiding element possesses a curved surface over which the fibrous suspension is guided by means of at least one wire.

36. Method in accordance with claim 35,

characterized in that

the curvature radius of the surface is larger than 2 m, especially larger than 5 m and preferably larger than 10 m.

37. Method in accordance with claim 35 or 36,

characterized in that

the angle of wrap is in a range of approximately 10° to approximately 30°.

38. Method in accordance with one of the aforementioned claims,

characterized in that

the dewatering, forming and/or wire guiding elements are adjustable in sections, viewed in cross direction.

39. Method in accordance with claim 38,

characterized in that

the adjustment parameters of the dewatering, forming and/or wire guiding elements that are - viewed cross directionally – arranged in sections and/or are sectionally adjustable are adjusted correspondingly in order to influence a respective property profile of the fiber material web.

40. Method in accordance with claim 39,

characterized in that

respective changes in the adjustment parameters of the dewatering, forming and/or wire guiding elements that are – when viewed cross directionally – arranged in sections and/or are sectionally adjustable can occur on the basis of off-line measurements, especially steady state.

41. Method in accordance with claim 40,
characterized in that
a respective change of the adjustment parameters of the dewatering, forming and/or wire guiding elements that are – when viewed cross directionally – arranged in sections and/or are sectionally adjustable occurs manually or through a control system.

42. Method in accordance with claim 40,
characterized in that
a respective change of the adjustment parameters of the dewatering, forming and/or wire guiding elements that are – when viewed cross directionally – arranged in sections and/or are sectionally adjustable occurs through at least a closed control loop.

43. Method in accordance with claim 42,
characterized in that
at least one closed control loop is utilized that encompasses an in-line acquisition of the product characteristic that is to be influenced, or a characteristic correlating with said product characteristic, a control algorithm and the relating final control element, such as especially the relating dewatering, forming and/or wire guiding element.

44. Method in accordance with claim 43,
characterized in that

at least one control algorithm is incorporated into the closed control loop for mapping.

45. Method in accordance with one of the aforementioned claims,
characterized in that
the angle of attack of the dewatering, forming and/or wire guiding elements is adjustable relative to the direction of web travel.

46. Method in accordance with one of the aforementioned claims,
characterized in that
a dewatering box is used that is equipped with several vacuum zones and/or elements that are arranged successively in transverse direction, and through which especially the longitudinal/cross relationship can be influenced.

47. Method in accordance with one of the aforementioned claims,
characterized in that
a dewatering box comprising a cover or plate that is diagonally slotted relative to the direction of web travel is used.

48. Method in accordance with one of the aforementioned claims,
characterized in that
a dewatering box that is equipped wit foil strips that are arranged diagonally to the direction of web travel is used.

49. Method in accordance with one of the aforementioned claims,
characterized in that
the vacuum in the individual vacuum zones is individually controllable.

50. Method in accordance with one of the aforementioned claims,
characterized in that
the dewatering, forming and/or wire guiding elements or the dewatering box are equipped with at least one slot having a changeable slot width.

51. Method in accordance with claim 50,
characterized in that
a vacuum supply that is sectioned in cross direction is provided.

52. Method in accordance with claim 50,
characterized in that
only the slot width is adjustable, meaning that no cross directionally sectioned vacuum treatment occurs.

53. Method in accordance wit one of the aforementioned claims,
characterized in that
the zones that are located successively in cross direction partially overlap.

54. Method in accordance with one of the aforementioned claims,
characterized in that
the respective foil angle is in a range of 0° to approximately 5°, and preferably in a range of 0° to approximately 3°.

55. Method in accordance with one of the aforementioned claims,
characterized in that
a dewatering box with a perforated cover or plate is utilized.

56. Method in accordance with one of the aforementioned claims,
characterized in that
forming board, a dewatering box with at least one slotted or perforated cover or plate, and several foil boxes are utilized.

57. Method in accordance with one of the aforementioned claims,
characterized in that
the fibrous suspension can be treated with vacuum in a range of 0 kPa to approximately 50 kPa, and preferably in a range of 0 kPa to approximately 25 kPa.

58. Application of the method in accordance with one of the aforementioned claims, in conjunction with a Foudrinier-Former, a Twin Wire Former, especially a Gap-Former or a Hybrid-Former, or a graphic Former.

59. Application of the method in accordance with one of the aforementioned claims in a machine equipped with several sheet formers for multi-ply products.

60. Application in accordance with claim 59, whereby the control or regulator system is effective only upon one ply.

61. Application in accordance with claim 59, whereby the control or regulator system is effective upon at least two plies.

62. Application in accordance with claim 61, whereby the control or regulator system is effective upon all plies.

63. Application of the method in accordance with one of the aforementioned claims, in conjunction with a medium stock consistency in a range of approximately 0.1% to approximately 7% and preferably in a range of approximately 0.5% to approximately 5%.

64. Application of the method in accordance with one of the aforementioned claims in conjunction with stocks containing recovered paper, especially liner, carton and/or graphic papers, especially having a medium stock consistency in a range of approximately 0.3% to approximately 7%.

65. Application of the method in accordance with one of the aforementioned claims in conjunction with sack Kraft papers, especially having a medium stock consistency in a range of approximately 0.1% to approximately 4%.

66. Application of the method in accordance with one of the aforementioned claims, to influence at least one of the following properties of the fiber material web:
    - Forming
    - Tear length ratio R_l/R_Q.

67. Device for the production of a fiber material web, particularly a paper, cardboard or tissue web from a fibrous suspension, especially in accordance with one of the aforementioned claims 3 through 20. The said device comprises a forming zone and means by which at least zonal pressure gradients are produced in the fibrous suspension during dewatering in the forming zone, in order to appropriately influence the principal fiber orientation.

68. Device in accordance with claim 67,
    characterized in that
    the fibrous suspension can be treated with vacuum during dewatering in the forming zone.

69. Device in accordance with claim 68,
    characterized in that

the means for producing pressure gradients and/or the means for vacuum application are sectioned, when viewed in cross-machine direction.

70. Device in accordance with claim 69,
characterized in that
a cross-directionally sectioned vacuum chamber is provided.

71. Device in accordance with one of the aforementioned claims,
characterized in that
the pressure gradient generation and/or vacuum treatment is controlled and/or regulated.

72. Device in accordance with one of the aforementioned claims,
characterized in that
one or several dewatering, forming and/or wire guiding elements are provided for the generation of the pressure gradients.

73. Device in accordance with claim 72,
characterized in that
the fiber material web that is formed from the fibrous suspension is carried over the dewatering, forming and/or wire guiding elements by at least one wire.

74. Device in accordance with one of the aforementioned claims,
characterized in that
foils trips that are positioned diagonally to the direction of web travel are provided as dewatering, forming and/or wire guiding elements.

75. Device in accordance with one of the aforementioned claims,
characterized in that
at least one dewatering box equipped with diagonally slotted plate cover relative to the direction of web travel and providing a foil effect is provided for dewatering, forming and/or wire guiding.

76. Device in accordance with claim 75,
characterized in that
the diagonally progressing bars in the plate cover are beveled on the discharge side.

77. Device in accordance with one of the aforementioned claims,
characterized in that
the dewatering box can be supplied with vacuum.

78. Device in accordance with one of the aforementioned claims,
characterized in that
a preferably controlled and/or regulated dewatering box that is supplied with vacuum is provided.

79. Device in accordance with claim 77 or 78,
characterized in that
at least one dewatering box is provided in combination with at least one graduated foil.

80. Device in accordance with one of the aforementioned claims,
characterized in that

at least one dewatering box is provided in combination with so-called Varioline strips (especially IBS Varioline System)

81. Device in accordance with one of the aforementioned claims,
characterized in that
at least one dewatering, forming and/or wire guiding element possesses a curved surface over which the fibrous suspension is carried by means of at least one wire

82. Device in accordance with claim 81,
characterized in that
the curvature radius of the surface is larger than 2 m, especially larger than 5 m, and preferably larger than 10 m.

83. Device in accordance with claim 81 or 82,
characterized in that
the angle of wrap is in a range of approximately 10° to approximately 30°.

84. Device in accordance with one of the aforementioned claims,
characterized in that
the dewatering, forming and/or wire guiding elements are arranged in sections, when viewed cross directionally, and/or are sectionally adjustable.

85. Device in accordance with claim 84,
characterized in that
the adjustment parameters of the dewatering, forming and/or wire guiding elements that are - when viewed cross directionally – arranged in sections and/or are sectionally adjustable are adjusted correspondingly in order to influence a respective property profile of the fiber material web.

86. Device in accordance with claim 85,

characterized in that

a respective change in the adjustment parameters of the dewatering, forming and/or wire guiding elements that are – when viewed cross directionally – arranged in sections and/or are sectionally adjustable occurs on the basis of off-line measurements, especially steady state.

87. Device in accordance with claim 86,

characterized in that

a respective change of the adjustment parameters of the dewatering, forming and/or wire guiding elements that are – when viewed cross directionally – arranged in sections and/or are sectionally adjustable occurs manually or through a control system.

88. Device in accordance with claim 86,

characterized in that

a respective change of the adjustment parameters of the dewatering, forming and/or wire guiding elements that are – when viewed cross directionally – arranged in sections and/or are sectionally adjustable occurs through at least a closed control loop.

89. Device in accordance with claim 87,

characterized in that

at least one closed control loop is provided that encompasses an in-line acquisition of the product characteristic that is to be influenced, or a characteristic correlating with said product characteristic, a control algorithm and the relating final control element, such as especially the relating dewatering, forming and/or wire guiding element.

90. Device in accordance with claim 89,
    characterized in that
    at least one control algorithm is incorporated into the closed control loop, for mapping.

91. Device in accordance with one of the aforementioned claims,
    characterized in that
    the angle of attach of the dewatering, forming and/or wire guiding elements is adjustable relative to the direction of web travel.

92. Device in accordance with one of the aforementioned claims,
    characterized in that
    a dewatering box is provided that is equipped with several vacuum zones and/or elements that are arranged successively in transverse direction through which especially the longitudinal/cross relationship is influenced.

93. Device in accordance with one of the aforementioned claims,
    characterized in that
    a dewatering box comprising a cover or plate that is diagonally slotted relative to the direction of web travel is provided.

94. Device in accordance with one of the aforementioned claims,
    characterized in that
    a dewatering box that is equipped with foils trips that are arranged diagonally to the direction of web travel is provided.

95. Device in accordance with one of the aforementioned claims,
    characterized in that

the vacuum in the individual vacuum zones is individually controllable.

96. Device in accordance with one of the aforementioned claims,
characterized in that
the dewatering, formation and/or wire guiding elements, or the dewatering box are provided with at least one slot having an adjustable slot width.

97. Device in Accordance with claim 96,
characterized in that
a vacuum supply that is sectioned in cross direction is provided.

98. Device in accordance with claim 96,
characterized in that
only the slot width is adjustable, in other words, no vacuum treatment that is sectioned in cross direction occurs.

99. Device in accordance with one of the aforementioned claims,
characterized in that
the zones that are located successively in cross direction overlap partially.

100. Device in accordance with one of the aforementioned claims,
characterized in that
the respective foil angle is in a range of 0° to approximately 5°m and preferably in a range of 0° to approximately 3).

101. Device in accordance with one of the aforementioned claims,
characterized in that
a dewatering box having a perforated cover or plate is provided.

102.Device in accordance with one of the aforementioned claims,

characterized in that

a forming board, a dewatering box with at least a slotted or perforated cover or plate, and several foil boxes are provided.

103.Device in accordance with one of the aforementioned claims,

characterized in that

the fiber suspension can be treated with vacuum in a range of 0 kPa to approximately 50 kPa, and preferably in a range of 0 kPa to approximately 25 kPa.

104.Device in accordance with one of the aforementioned claims,

characterized in that

it comprises a Foudrinier Former, a Twin Wire Former, especially a Gap-Former or Hybrid Former, or a graphic former.

105.Device in accordance with one of the aforementioned claims,

characterized in that

it comprises several sheet forming devices for multi-ply products.

106.Device in accordance with claim 105,

characterized in that

a control or regulator system is provided, relative to only one ply.

107.Device in accordance with claim 105,

characterized in that

a control or regulator system is provided, relative to at least two plies.

108. Device in accordance with claim 107,

characterized in that

the control or regular system is provided relative to all plies.

109. Device in accordance with one of the aforementioned claims,

characterized in that

with a medium stock consistency of the fiber suspension, the pressure gradients are generated in a range of approximately 0.1% to approximately 7%, and preferably in a range of approximately 0.5% to approximately 5%.

110. Utilization of the device in accordance with one of the aforementioned claims in conjunction with stocks containing recovered paper, especially liner, carton and/or graphic papers, especially having a medium stock consistency in a range of approximately 0.3% to approximately 7%.

111. Utilization of the device in accordance with one of the aforementioned claims in conjunction with sack Kraft papers, especially having a medium stock consistency in a range of approximately 0.1% to approximately 4%.

112. Utilization of device method in accordance with one of the aforementioned claims, to influence at least one of the following properties of the fiber material web:

- Forming
- Tear length ratio R_L/R_Q.

Fig. 1

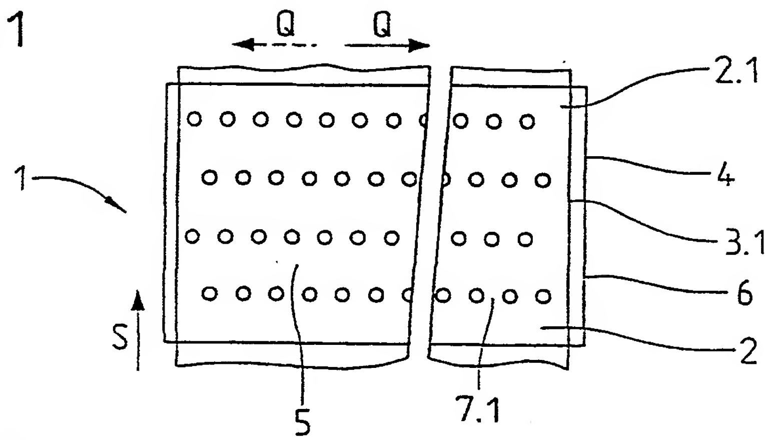


Fig. 2a

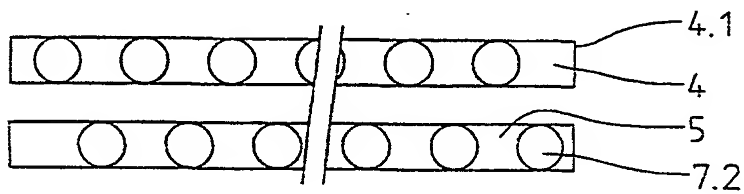


Fig. 2b

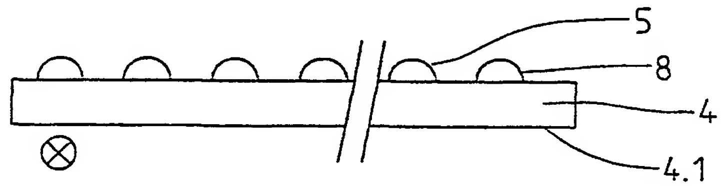


Fig. 3a

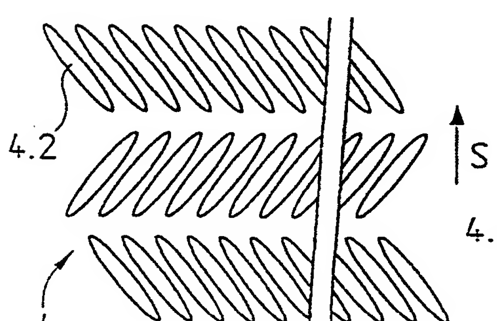


Fig. 3b

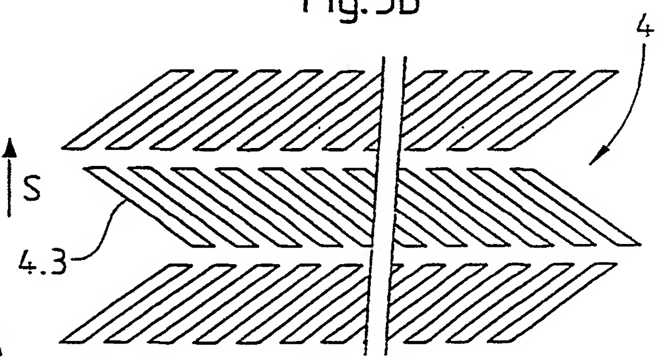


Fig. 3c

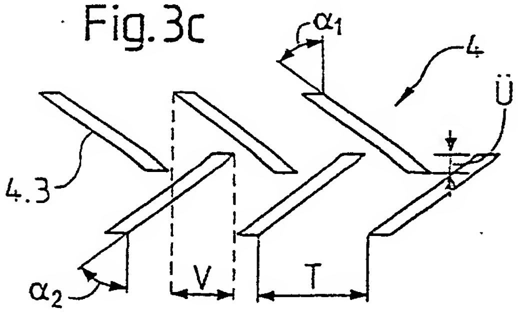


Fig. 3d

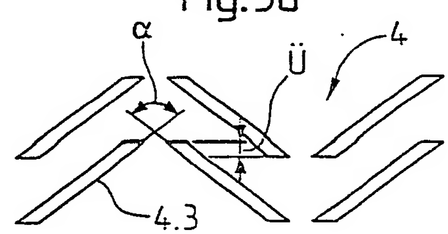


Fig.4a

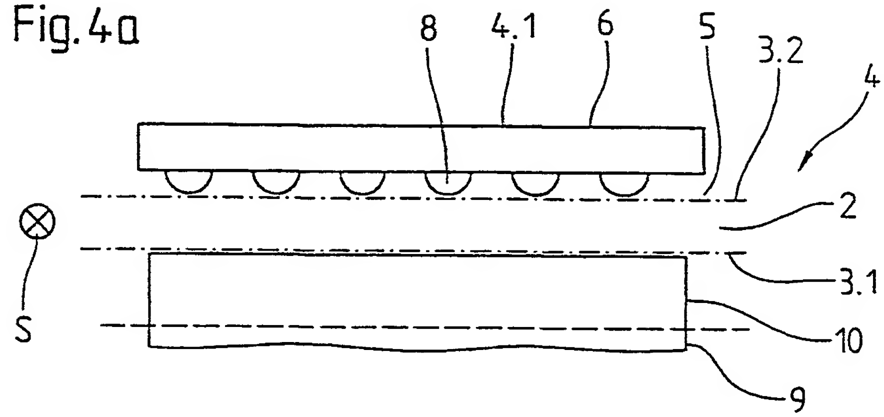


Fig.4b

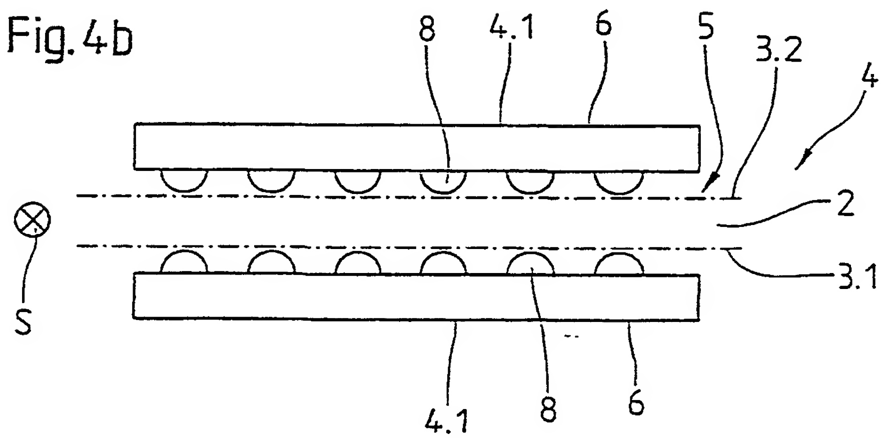


Fig.4c

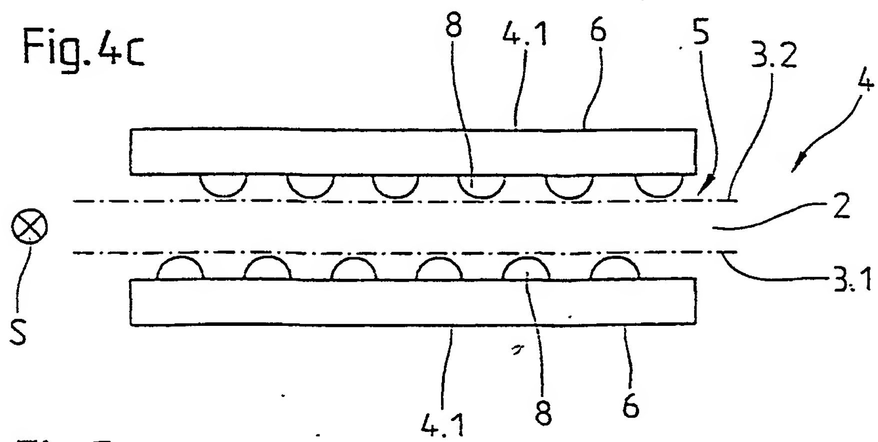


Fig.5

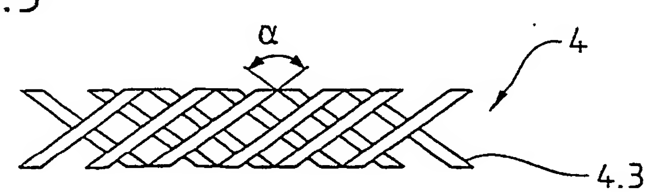


Fig.6

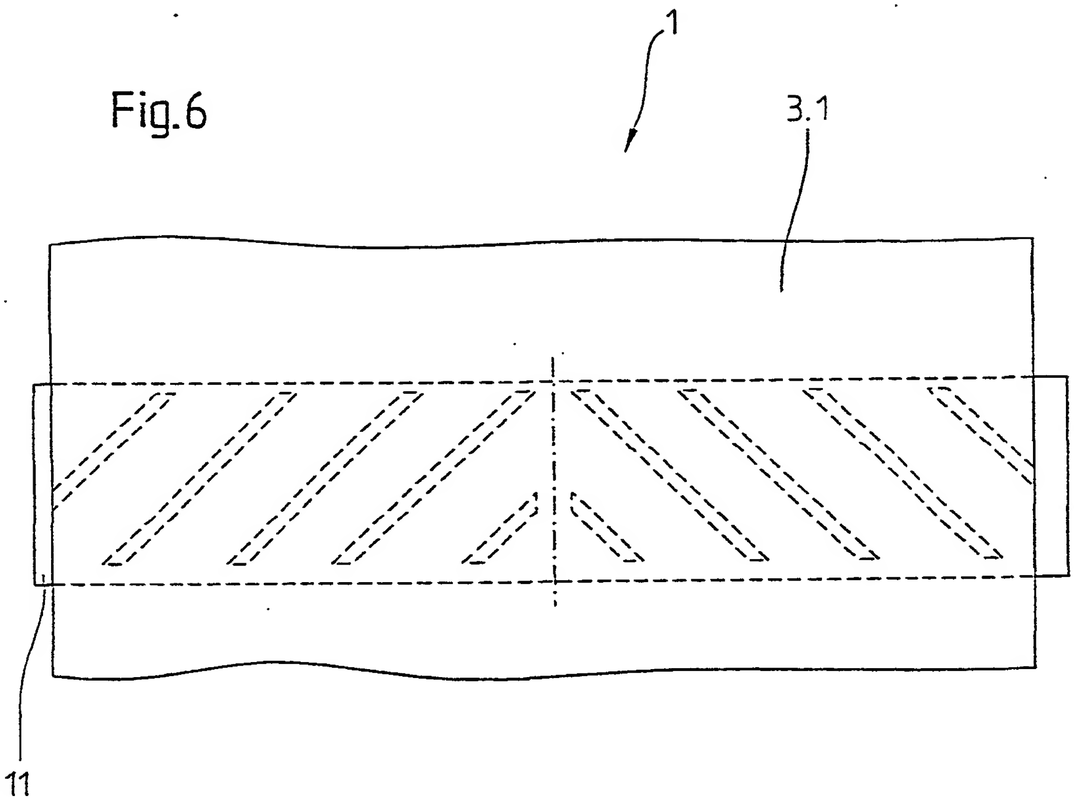


Fig.7

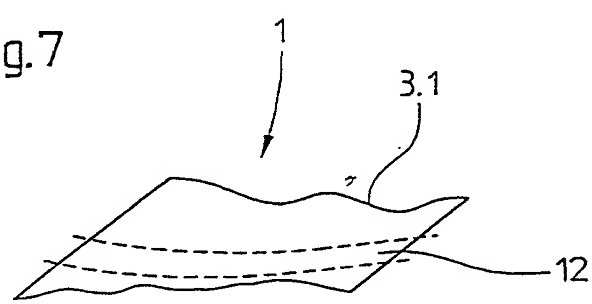


Fig. 8

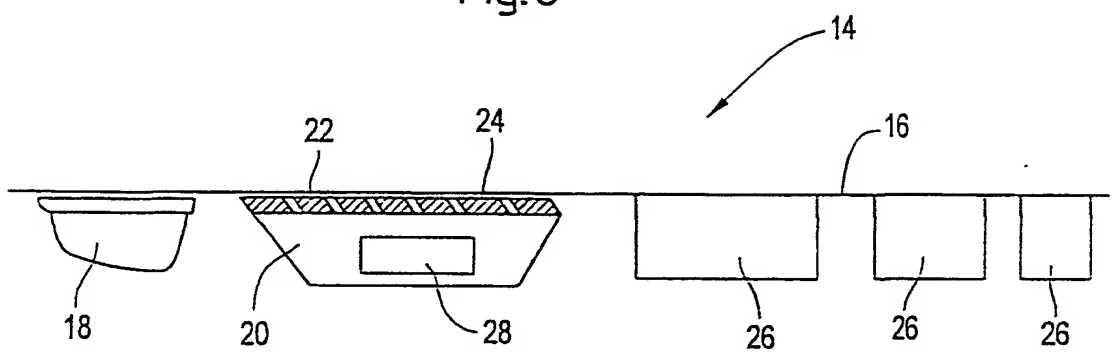
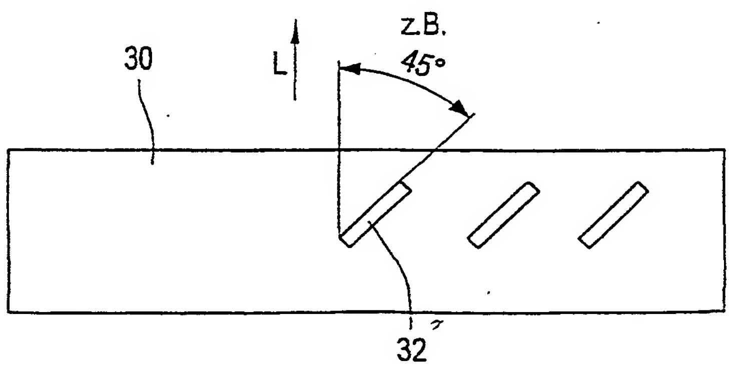
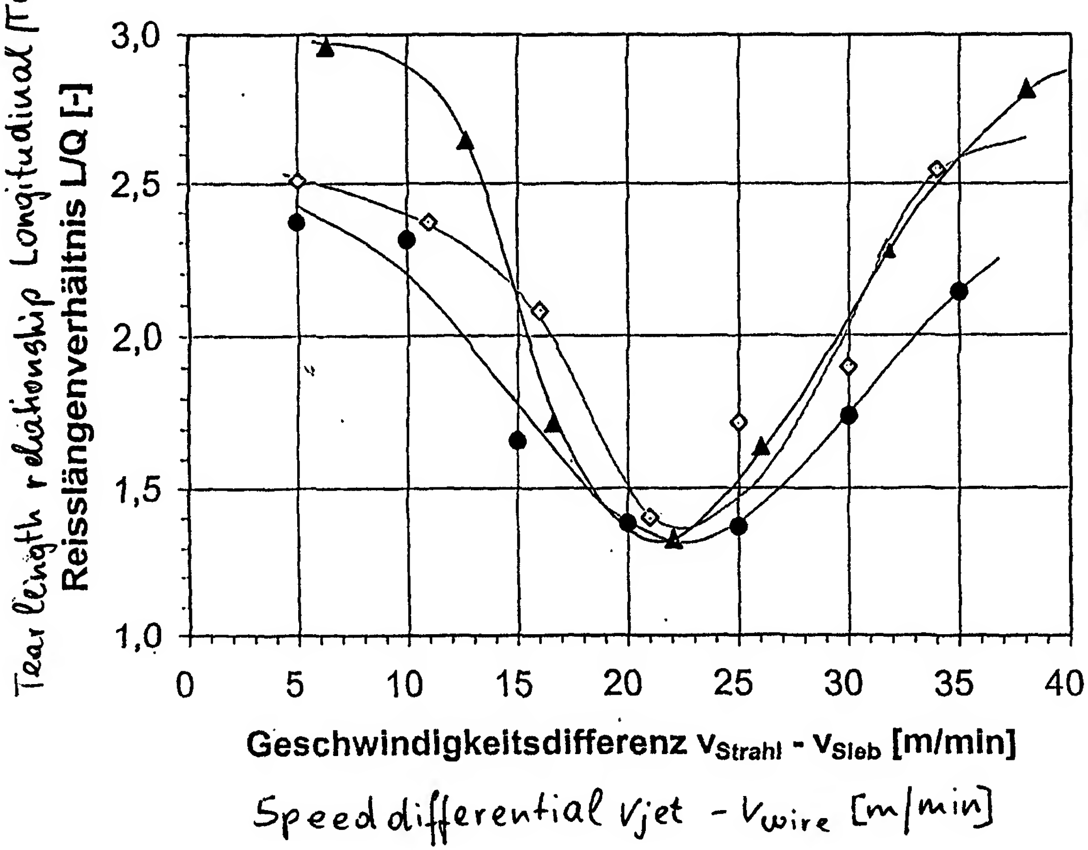


Fig. 9



Suction box w/diagonally slotted plate
Tensile stiffnes relationship longitudinal/transverse with and w/o vacuum

Schrägschlitzplattensauger
Festigkeitsverhältnis längs/quer mit und ohne Vakuum



Speed : 800 m/min.
Geschwindigkeit: 800 m/min
FbM: 55 g/m2
Rohstoff: LF (KEMI: UBKP+30%Broke)
Raw material :

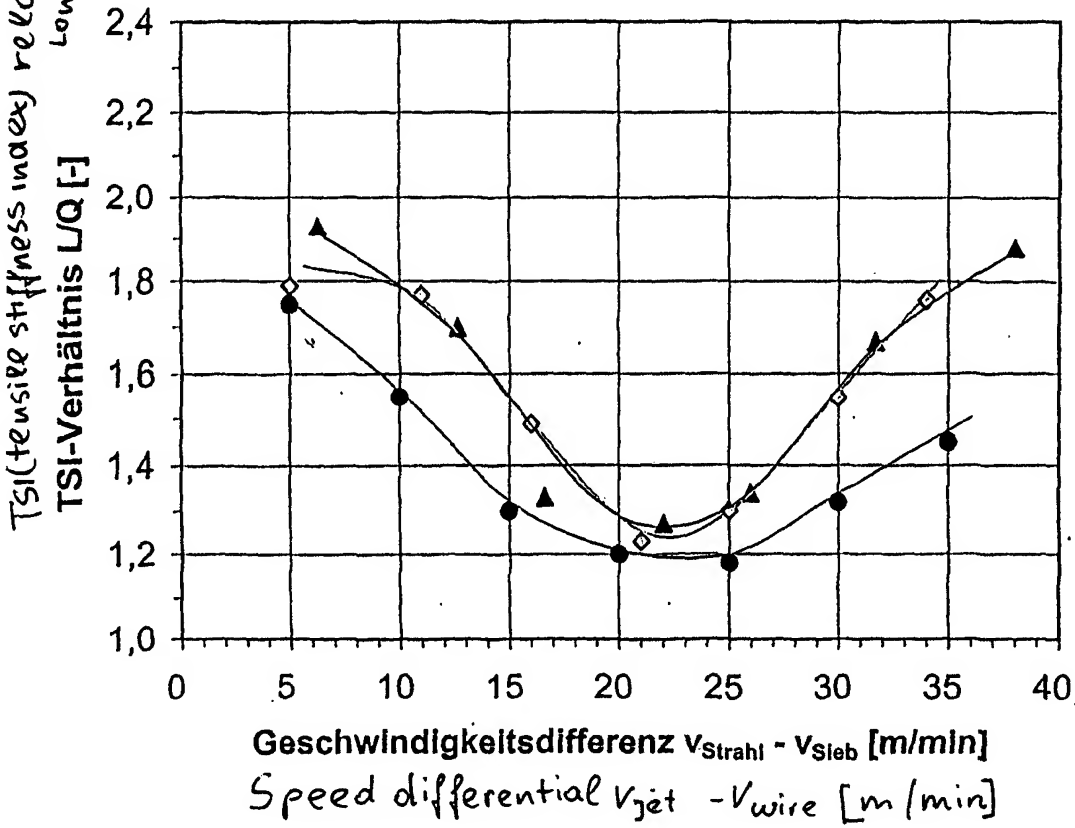
● RL L/Q, SSPS mit Vakuum - with vacuum
◇ RL L/Q, SSPS ohne Vakuum - without vacuum
▲ RL L/Q, Foilkasten mit Vakuum Foilbox with vacuum

RL : Tear length
L/Q : Longitudinal /transverse
SSPS, suction box w/diagonally slotted plate

Fig. 10

Suction box w/diagonalley slotted plate
Tensile stiffness relationship longitudinal/transverse with and w/o vacuum

Schrägschlitzplattensauger
Festigkeitsverhältnis längs/quer mit und ohne Vakuum



Speed: 800 m/min
Geschwindigkeit: 800 m/min
FbM: 55 g/m2
Rohstoff: LF (KEMI: UBKP+30%Broke)
raw material:

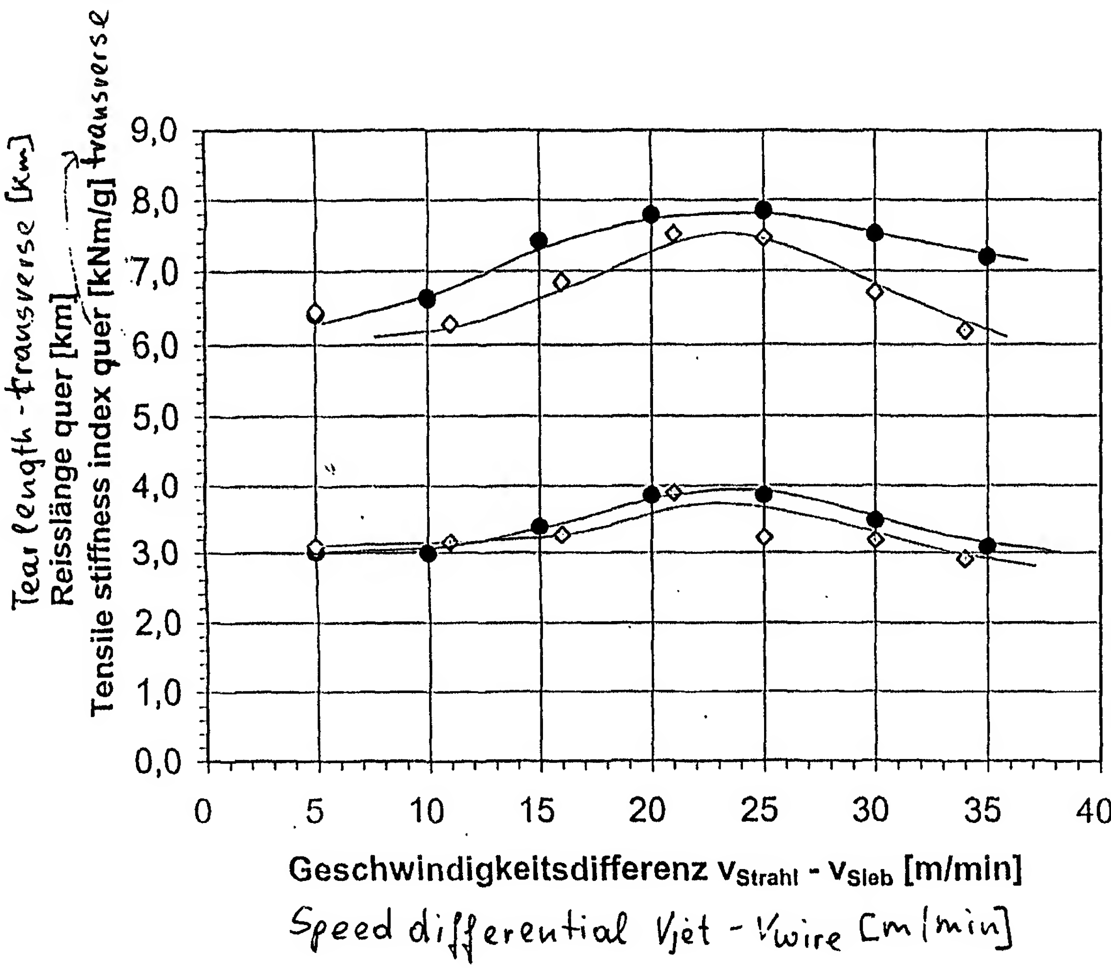
- ● TSI L/Q, SSPS mit Vakuum with vacuum
- ◇ TSI L/Q, SSPS ohne Vakuum without vacuum
- ▲ TSI L/Q, Foilkasten mit Vakuum Foilbox with vacuum

TSI = tensile stiffness index
L/Q = Longitudinal/transverse
SSPS = suctionbox w/diagonally slotted plate

Fig. 11

Suctionbox w/diagonally slotted plate
Transverse strength with and without vacuum on the diagonally slotted plate suction box.

Schrägschlitzplattensauger
Querfestigkeit mit und ohne Vakuum am SSP-Sauger



Speed: 800m/min
Geschwindigkeit: 800 m/min
FbM: 55 g/m2
Rohstoff: LF (KEMI: UBKP+30%Broke)
Raw material:

● RL L/Q, SSPS mit Vakuum	with vacuum
◇ RL L/Q, SSPS ohne Vakuum	without vacuum
● TSI L/Q, SSPS mit Vakuum	with vacuum
◇ TSI L/Q, SSPS ohne Vakuum	without vacuum

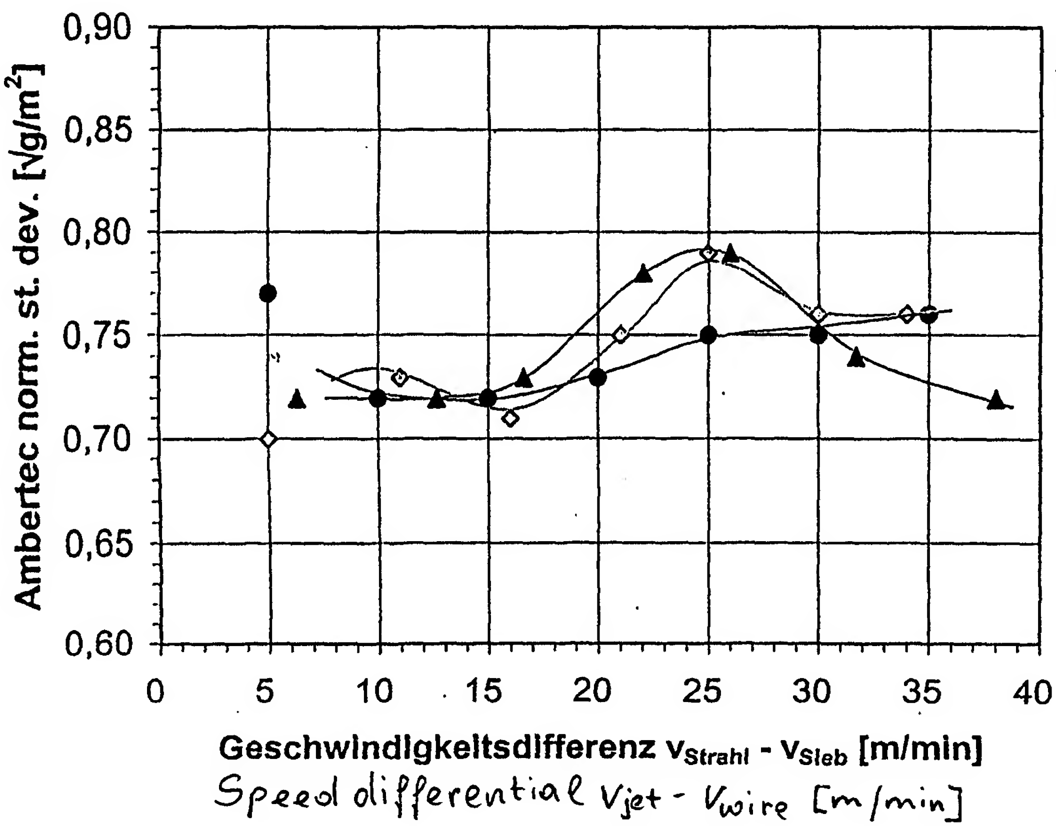
RL - tear length
L/Q - longitudinal/transverse
TSI - tensile stiffnes index

Fig. 12

SSPS - Suction box w/diagonally slotted plate

Suctionbox w/diagonally slotted plate
Formation with and without vacuum

Schrägschlitzplattensauger
Formation mit und ohne Vakuum



Speed: 800 m/min.
Geschwindigkeit: 800 m/min
FbM: 55 g/m2
Rohstoff: LF (KEMI: UBKP+30%Broke)
Rawmaterial:

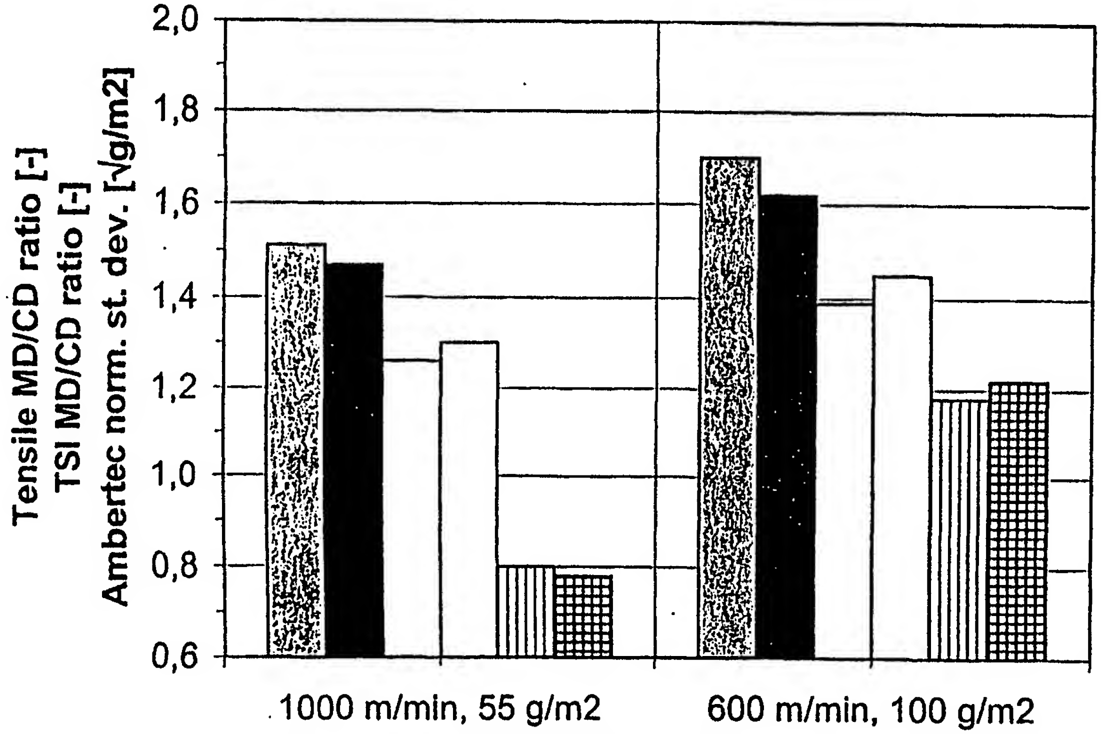
- ● RL L/Q, SSPS mit Vakuum — with vacuum
- ◇ RL L/Q, SSPS ohne Vakuum — without vacuum
- ▲ RL L/Q, Foilkasten mit Vakuum — Foilbox with vacuum

RL - tear length
L/Q - longitudinal/transverse
SSPS - Suction box w/diagonally slotted plate

Fig. 13

Suction box w/diagonally slotted plate
Tensile stiffness orientation with and without vacuum

Schrägschlitzplattensauger
Festigkeitsorientierung mit und ohne Vakuum



Speed:
Geschwindigkeit: 1000, 600 m/min

FbM: 55, 100 g/m3

Rohstoff: LF (KEMI: UBKP+30%Broke)
raw material:

- RL L/Q, SSPS mit Vakuum – with vacuum
- RL L/Q, SSPS ohne Vakuum · w/o vacuum
- TSI L/Q, SSPS mit Vakuum – with vacuum
- TSI L/Q, SSPS ohne Vakuum – w/o vacuum
- Ambertec, SSPS mit Vakuum – with vacuum
- Ambertec, SSPS ohne Vakuum – w/o vacuum

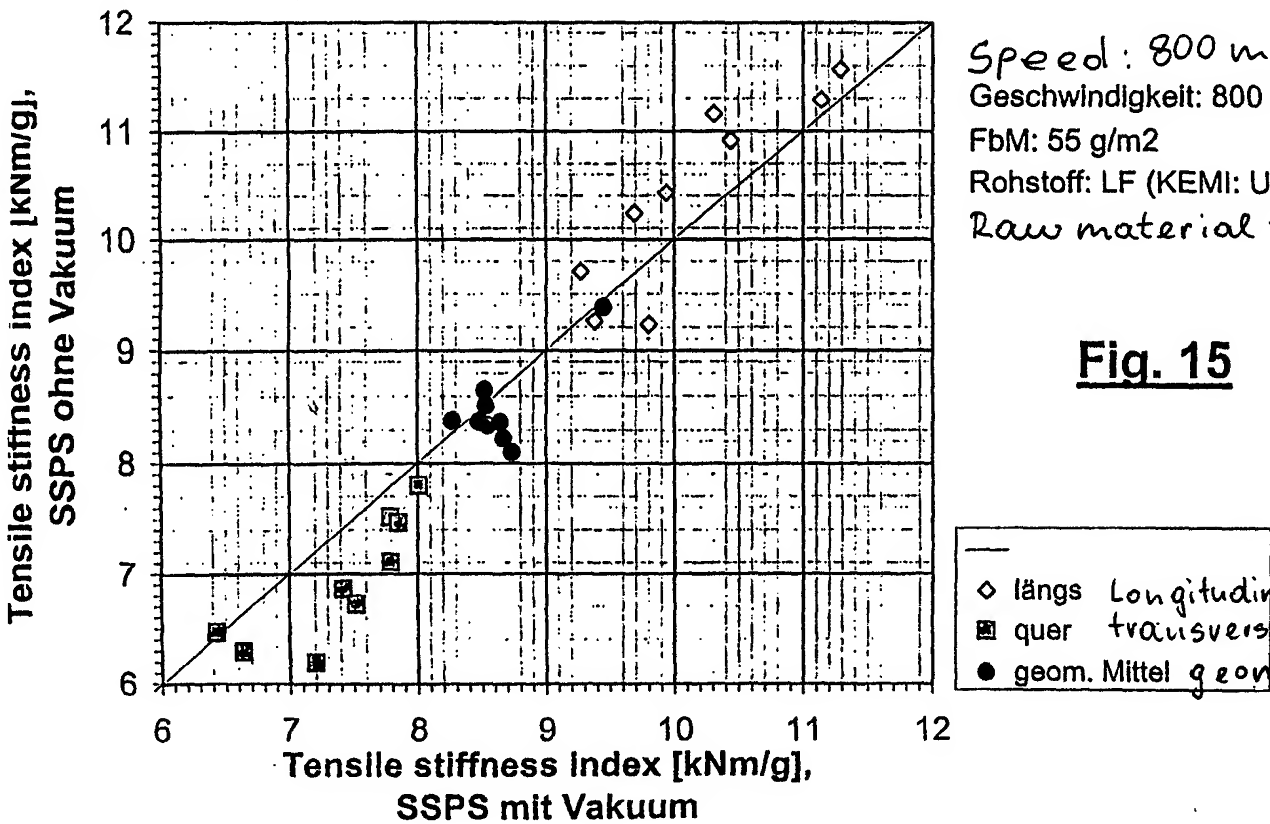
RL = tear length
L/Q: Longitudinal/transverse
TSI: tensile stiffness index

Fig. 14

SSPS = Suctionbox w/diagonally slotted plate

Suctionbox w/diagonally slotted plate
Tensile stiffness index with/without vaccum on suction box

Schrägschlitzplattensauger
TSI mit / ohne Vakuum am SSP-Sauger



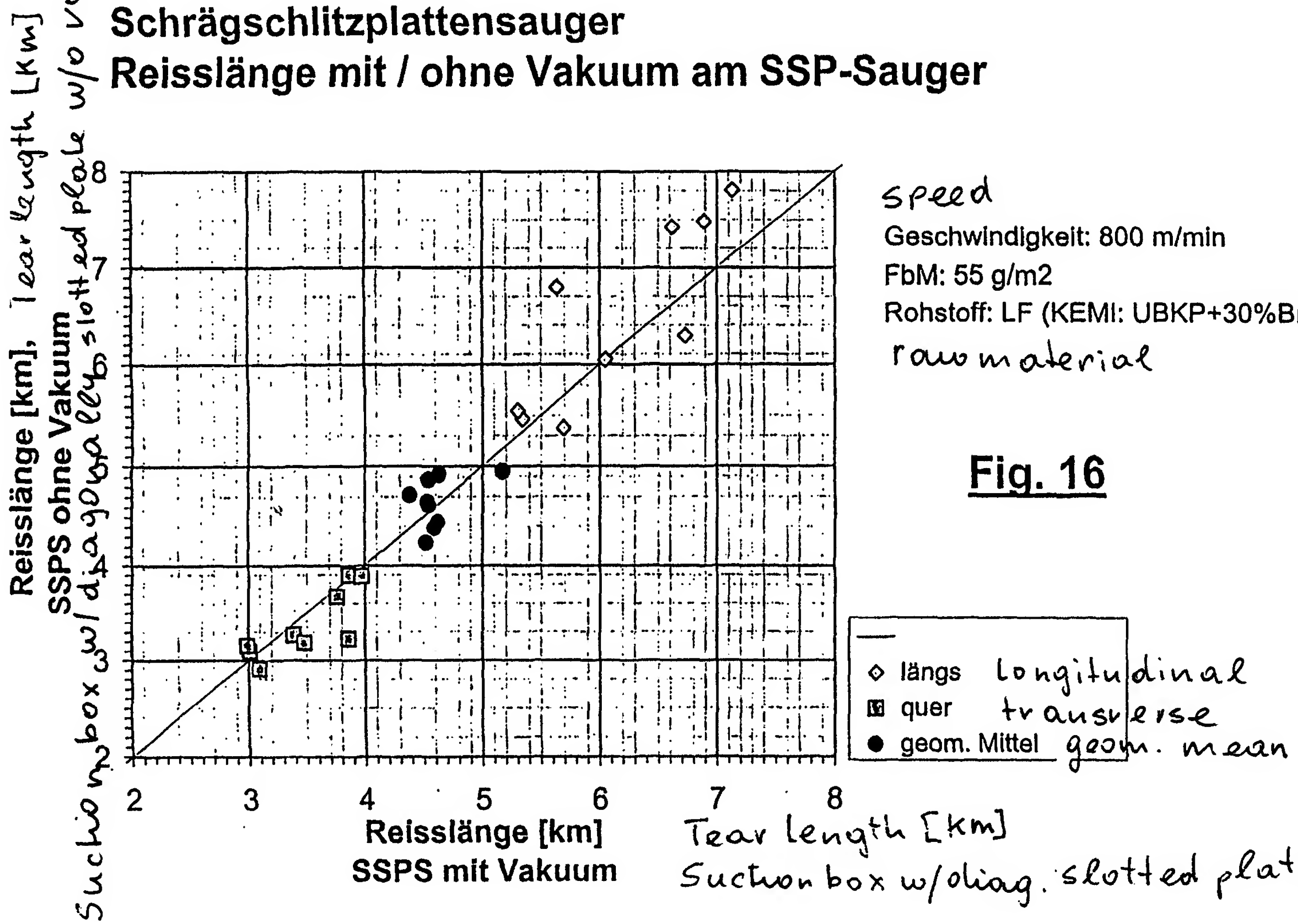
Speed: 800 m/min.
Geschwindigkeit: 800 m/min
FbM: 55 g/m2
Rohstoff: LF (KEMI: UBKP+30%Broke)
Raw material:

Fig. 15

Suctionbox w/diagonally slotted plate with vacuum

Suction box w/diagonally slotted plate
Tear length with/without vacuum at the suction box w/diag. slotted plate

Schrägschlitzplattensauger
Reisslänge mit / ohne Vakuum am SSP-Sauger



speed
Geschwindigkeit: 800 m/min
FbM: 55 g/m2
Rohstoff: LF (KEMI: UBKP+30%Broke)
raw material

Fig. 16

Suction box w/diagonally slotted plate
Tensile stiffness orientation with and without vacuum

Schrägschlitzplattensauger
Festigkeitsorientierung mit und ohne Vakuum

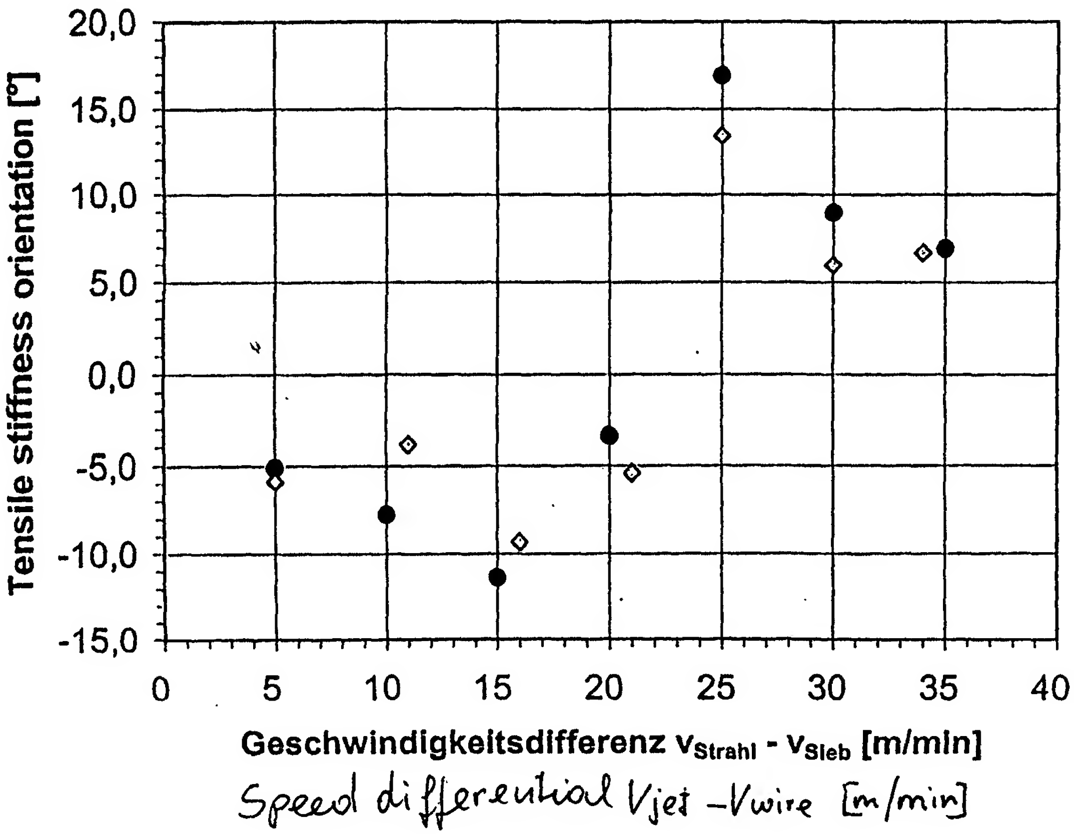


Fig. 17

● RL L/Q, SSPS mit Vakuum - with vacuum
◇ RL L/Q, SSPS ohne Vakuum w/o vacuum

RL = Tear length
L/Q = Longitudinal/Transverse
SSPS: Suction box w/diagonally slotted plate

Fig. 18

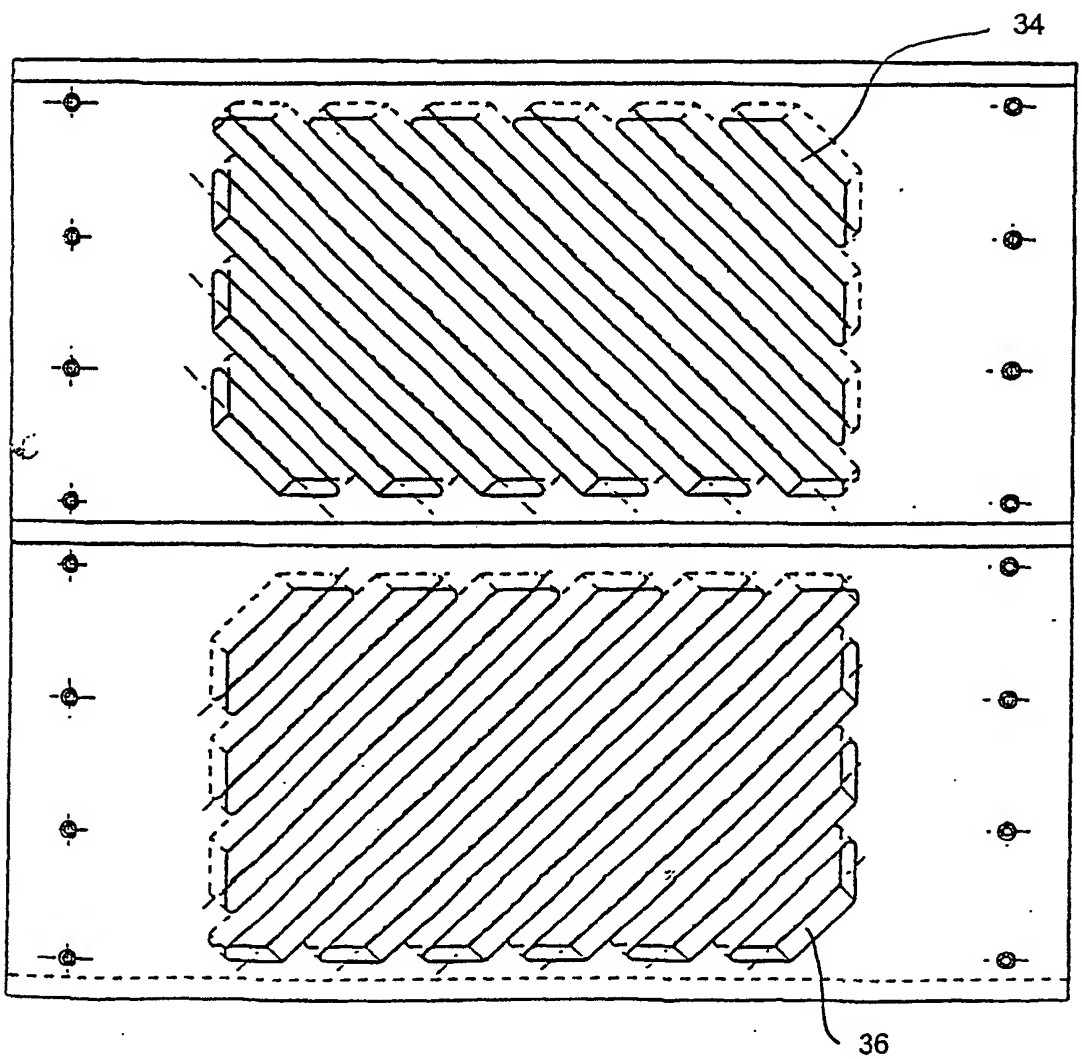


Fig. 19

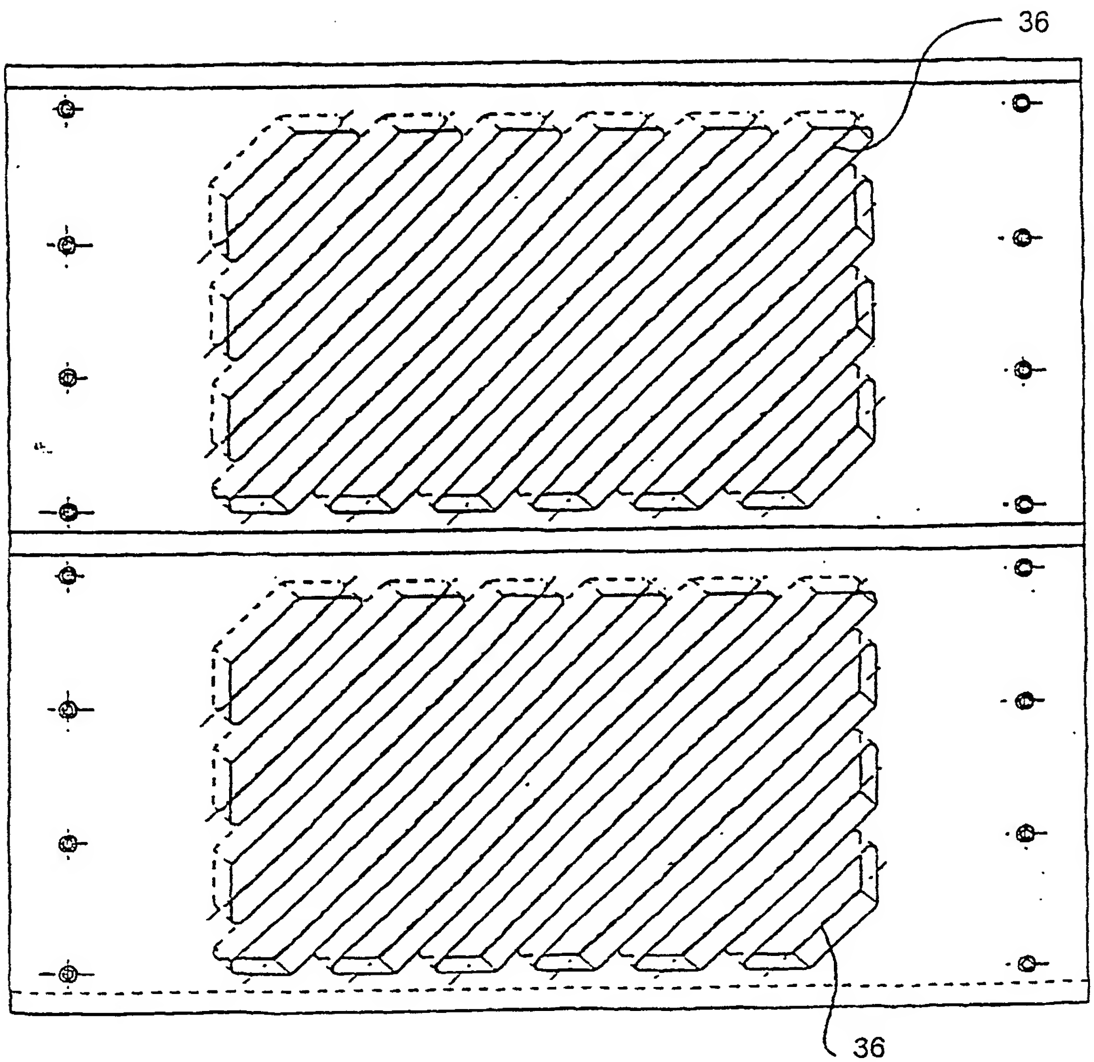
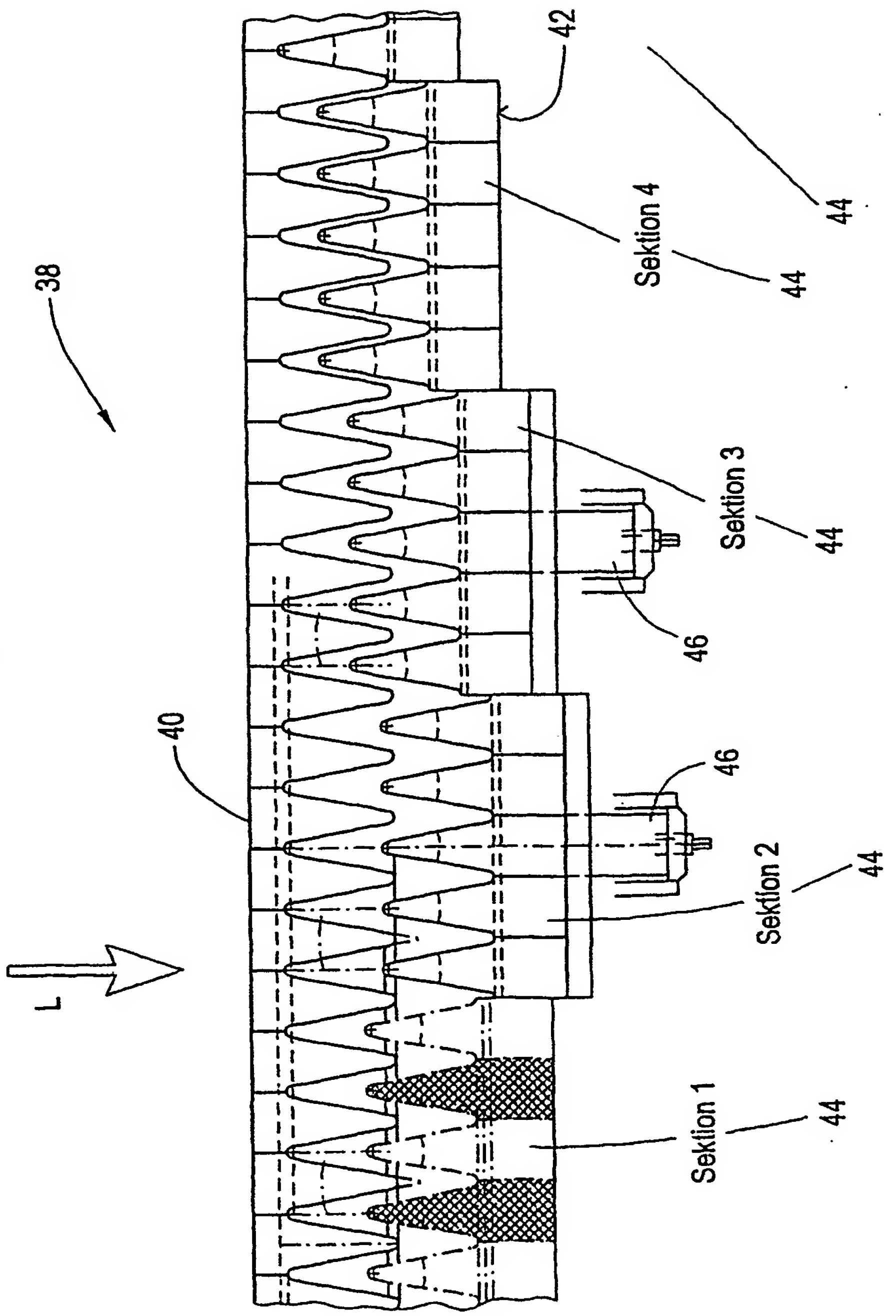


Fig.20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Sektion 4
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Sektion 3
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Sektion 2
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Sektion 1
44

Fig. 21

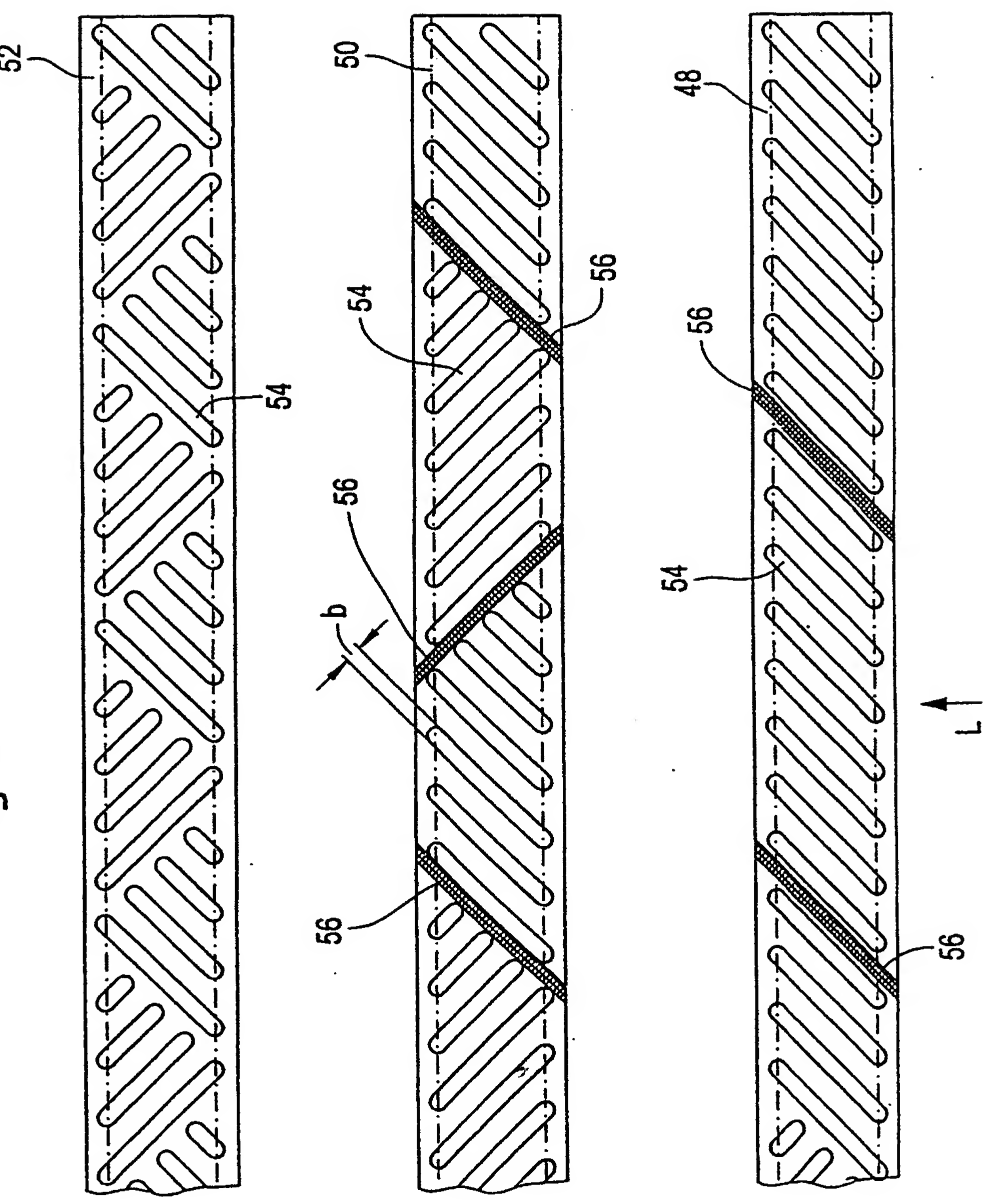

Fig.22

Paper web